CORRELATION OF THE CHANGE IN DEGREE OF STRAIGHT LEG RAISING TEST IN THE EARLY POSTOPERATIVE PERIOD WITH CHANGE IN LEG PAIN AND FUNCTIONAL OUTCOMES AFTER LUMBAR DISCECTOMY

Dissertation submitted to the Tamil Nadu Dr.M.G.R. Medical University, Chennai, for the part II M.Ch. Neurosurgery Examination, February 2011.

DEPARTMENT OF NEUROLOGICAL SCIENCES
CHRISTIAN MEDICAL COLLEGE
VELLORE

CERTIFICATE

This is to certify that the dissertation titled "**Correlation of the change in degree of straight leg raising test in the early postoperative period with change in leg pain and functional outcomes after lumbar discectomy**" is the bonafide work of Dr. Ipe V.George submitted in partial fulfillment of the rules and regulations, for Branch-II M.Ch. Neurosurgery, Part-II examination of the Tamil Nadu Dr. M.G.R. Medical University to be held in February 2011.

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ABBREVIATIONS

SLRT	Straight leg raising test
ODI	Oswestry disability index
IVDP	Intervertebral disc prolapse
VAS	Visual analogue scale
ADE	Anterior disc extrusions
PDE	Posterior disc extrusions
LBP	Low back pain
pSLRT	Passive straight leg raising test
FNST	Femoral nerve stretch test
CSLRT	Crossed straight leg raising test
LDH	Lumbar disc herniation
TENS	Transcutaneous electrical nerve stimulation
PAN	Percutaneous automated nucleotomy
PD	Percutaneous discectomy
PED	Percutaneous endoscopic discectomy
ADL	Activities of daily living
SF-36	Short Form-36
LBOS	Low back outcome score
MSPQ	Modified somatic perceptions questionnaire
MZ	Modified Zung score
NRS	Numeric rating scales for back (BP) and leg pain (LP)
SPORT	Spine Patient Outcomes Research Trial
STATA	Statistical analysis software

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AIMS AND OBJECTIVES

The aims and objectives of the present work are:

I. To study the correlation between the change in the degree of straight leg raising test in the immediate preoperative period and seven days postoperative with the improvement in leg pain as assessed by the visual analogue score (VAS) assessed on the seventh postoperative day.

II. To study the correlation between the change in the degree of straight leg raising test in the immediate preoperative period and seven days postoperative with the long-term improvement in leg pain as assessed by the visual analogue score (VAS) assessed six months after surgery.

III. To study the correlation between the change in the degree of straight leg raising test in the immediate preoperative period and seven days postoperative with the outcome as assessed by the Macnab's score and revised Oswestry Disability Index at 6 month and 1 year postoperation.

INTRODUCTION

Called one of the great scourges of humanity, sciatica dates back to Domenico Cotugno's *De ischiade nervosa commentarius* in 1764 (1). Sciatica is a very common complaint but its etiopathophysiology was unclear till even the mid 1920s to the mid 1930s when it was believed to be due to infective or neoplastic processes (2). Walter E. Dandy in his 1929 publication "Loose cartilage from the intervertebral disc simulating tumour of the spinal cord " and 5 years later Mixter and Barr in their publication in 1934, the "Rupture of the intervertebral disc with involvement of the spinal canal " described the intervertebral disc herniation for the first time (1).

The intervertebral disc prolapse is commonly seen in individuals between 30 -50 years of age, although it may occur in younger or older individuals. Preventive measures for disc prolapse have not been very successful (3).

The lumbar discs most often implicated in disc prolapse are the L4-5 and L5-S1 discs probably because of long standing degeneration and loss of the discs' ability to resist applied stress (4).

Back pain is strongly associated with degeneration of the intervertebral disc. Disc degeneration, although in many cases asymptomatic, is also associated with sciatica and disc herniation or prolapse. It alters disc height and the mechanics of the rest of the spinal column, possibly adversely affecting the behavior of other spinal structures such as muscles and ligaments (5).

The etiopathogenesis of the radicular pain and its treatment have been widely debated. In 1983 Weber showed that the natural history of lumbar disc herniation is to resolution (6). Weber and colleagues demonstrated improvement in sciatica of 70% of their nonhospitalised patients with nonsurgical measures (3). Back surgery is not the final common pathway for everyone with persistent back pain. It offers specific therapy for specific anatomical derangements associated with specific complexes of symptoms. When surgery ranges beyond carefully defined situations, we can expect disappointed patients(7).

It has been well supported by clinical evidence that sciatica can be managed by surgical intervention and that the early recovery rate and return to work are improved following surgical intervention (3). After the first year the results of surgery were the same as in the nonoperative treatment, though almost 40% of patients who were initially assigned to the nonsurgical group later underwent surgery (6-8).

Numerous studies have looked into the different treatment strategies, the indications for treatment and the factors that influence the outcomes (9, 10). The major cause of poor postoperative outcome remains inappropriate patient selection. The failure rates in literature vary from 1% to 48 % and averages between 10% to 20% in most series (11). The radicular pain, duration of symptoms, neurological signs, root tension signs, imaging findings and psychosocial environment have all been studied to prognosticate surgical outcome (11-14). In 1979 Sprengler and Freeman devised an objective rating scale for patient selection which was later revised by Herron and Turner in 1985 and was found to be highly predictive of a good patient outcome (11). Both back pain and leg pain were ameliorated by surgery, but leg pain resolved more quickly and fully than back pain. Thus, benefits are likely to be greatest for nerve-root-associated symptoms (7). Most patients return to their preoperative work or to a lighter job, usually by eight to ten weeks after surgery, but earlier for sedentary rather than manual workers(10).

The passive straight leg raising test (SLRT) is commonly used in the examination of low back and radicular pain and has a high sensitivity in detecting root compression (15-18). The diagnostic accuracy of the test is limited only by its low specificity. A satisfactory result is associated more often with markedly positive nerve-root tension tests(10).

A persistent postoperative SLRT at 4 months was found to be associated with a less than excellent clinical outcome and a 20% risk of reoperation (19). The degree of change in the SLRT in the immediate postoperative period compared to the preoperative assessment and its correlation to the outcome of surgery has not been studied previously.

REVIEW OF LITERATURE

In 1934, shortly before Mixter and Barr's paper, Putti operated on a patient with a sequestrated disc without fully realizing what he had done. He described this 'strange whitish material inside the canal' and understood that he was dealing with interesting and perhaps not yet known pathology (20). The intervertebral disc was first implicated as a causative factor in sciatica in the early 20th century. Schmorl and Andrae (1929) described posterior disc protrusions seen at post-mortem studies, but did not link these with sciatic pain and concluded they were probably asymptomatic in life (21).

Fortunately, only 4 % to 6 % of lumbar disc herniations (LDH) become symptomatic, with men being up to three times more likely than women to sustain a LDH (22). Lumbar disc herniation is one of the few causes of spinal pain that can be successfully treated surgically. Perhaps because of the insufficient knowledge of most other causes of spinal pain it has become a popular diagnosis. Risk factors for disc herniation include driving of motor vehicles, sedentary occupation, vibration, smoking, previous full-term pregnancy, physical inactivity, increased body mass, and a tall stature (3). The overall prognosis is favorable, with a strong tendency toward spontaneous healing: herniations shrink and may be resorbed. In most cases conservative treatment, pain control, and awaiting the natural course are enough (14). Although smaller herniations may be safely treated non-operatively, massive extrusions and sequestrations are sometimes treated by operation for fear of cauda equina compression. Broad-based protrusions, extrusions and sequestrations improved more than bulges and focal protrusions (6).

In 1983, Weber showed that the natural history of radiculopathy because of lumbar disc herniation is to clinical resolution. Surgery carried out in the first year gave earlier relief of pain, but thereafter the results of surgery were the same as those of non-operative treatment (6, 23).

Most patients hospitalized for sciatica will have suffered their first episode of acute low back pain while in their third decade of life. The initial episode is usually provoked by an acute traumatic event. An approximate mean of 10 years will pass before the onset of the first radicular symptoms (21). Weber attributed this long interval between onset of low-back pain and the onset of radicular pain to intradiscal degeneration and regeneration forces. Weber and colleagues were also able to demonstrate improvement over the course of 4 weeks in 70% of their 208 nonhospitalized patients with sciatica in whom nonsurgical intervention was performed. Sixty percent of those patients returned to work by the 4-week interval (3, 21). In patients in whom symptoms persisted for more than 3 months preoperatively, a far worse prognosis was demonstrated. In patients suffering low-back pain and/or sciatica for more than 6 months, the likelihood of successful rehabilitation is only approximately 40%(3).

The highest incidence of anterior disc extrusions (ADE) in the mid-lumbar spine contrasts with the distribution of posterior disc extrusions (PDE) that tends to involve the lower lumbar levels. Multivectorial extrusion, and thus the highest intrinsic extrusive tendency were the L3-L4 and L4-L5 levels, the two totaling 81 % of the lumbar levels with multivectorial extrusions. The total number of disk extrusions in all directions revealed that the L4-L5 level had the highest in absolute number followed by in decreasing frequency, the L5-S1 level and then the L3-L4, L2-L3, and finally L1 -L2 (24). Interestingly, the site of disc herniation appears to change with age. Although the majority of disc herniations occur at the L4/5 or L5/S1 level, with advancing age, there appears to be a relatively increased incidence of herniation at the L3/4 or even L2/3 level (21).

Generally the location of a protrusion was considered significant: a central prolapse produced low back pain (LBP); a posterolateral protrusion, both LBP and leg pain; and a lateral protrusion, leg pain alone (25, 26).

The signs and symptoms of nerve-root irritation due to a herniated lumbar intervertebral disc are now well established. Although myelography and MRI are useful tools for the preoperative

assessment of patients with persisting root irritation, the decision to operate cannot be dependent on imaging findings alone, but must be based on the clinical evaluation of the patient. There are five clinical criteria that are generally regarded as indications for surgery

1. Impairment of bladder or bowel function;
2. Gross motor weakness;
3. Evidence of increasing impairment of root conduction, despite complete bed rest;
4. Severe sciatic pain persisting or increasing, despite four weeks of complete bed rest, associated with evidence of root tension on examination;
5. Recurrent incapacitating episodes of sciatic pain with evidence of root tension, impairment of root conduction, or both.

From time to time however, despite an apparently classic history and typical findings suggestive of disc herniation, surgical exploration fails to reveal any lesion of an intervertebral disc (27). The empirically observed rates of halting disease progression with surgical intervention in cases in which these indications exist is so good that, given such symptoms, randomized clinical trials would be unethical. Such patients, however, represent a minority of the lumbar disc herniation population (3).

Radicular pain

"Sciatica" in Greek, literally means hip pain (28). Sciatic pain was defined by O'Connell in 1943 as pain along the course and in the distribution of the sciatic nerve, as distinct from LBP. Apart from the rare cases with massive neurologic deficits, pain is the main indication for lumbar disc surgery. However, pain is subjective by definition. Thus, many clinicians prefer to rely on criteria that seem to be more objective, and traditionally, much emphasis has been attached to neurologic signs. However, such signs often are absent and have no strong association with preoperative and postoperative pain, impairment, or disability (14).

The incidence of sciatica is related to age. Rarely seen before the age of 20, incidence peaks in the fifth decade and declines thereafter. The odds ratio (OR) of an episode of sciatica increased by 1.4 for every additional 10 years of age, up to the age of 64 (21).

The mechanism for radiculopathy related pain production has been a subject of considerable debate. Pathophysiologic findings associated with compression insults include edema formation and reduced blood flow (29) and eventually lead to intraneural inflammation and hypersensitivity. This then results in increased mechanosensitivity of the nerve root with regard to compression and the induction of pain. It is now generally accepted that a combination of mechanical and abnormal biochemical events is involved in the generation of radicular pain (3). Kelly, the first to challenge the compressive mechanism of sciatica, felt that pressure on a nerve would lead to loss of function and not pain alone (21). When the outer annulus is breached, pain ensues and the mechanism is most likely multifactorial (22).

However, herniation of the nucleus pulposus is not the only cause of sciatica and other causes should not be forgotten (21).

Far lateral disc herniations account for 1% to 12% of all disc herniations, with L4-5 level being the most common. The unique characteristic of these herniations is that instead of compressing the traversing nerve root of the level below, the herniation extends into or through the foramen and compresses the corresponding exiting nerve root (22).

Stimulation of stretched , compressed or swollen nerve roots caused pain in 100% patients and is the only tissue site that replicated the patient's sciatica (30). The dorsal root ganglion (DRG) was only somewhat more sensitive than the nerve roots. Only 8% of stimulation of normal nerve roots caused any significant pain. Contact with the nucleus pulposus may alter vascular permeability and/or activate endothelial cells, which then hypertrophy and reduce the diameter of the vascular lumen (29). Mechanical compression, inflammatory agents and obstructive venous outflow have all been implicated but never proven to be a cause of the nerve root pain (29, 30).

The perivascular innervation of radicular arteries and extraparenchymal arteries of the spinal cord were invested with nerve fibers that contain adrenergic, neuropeptide Y, vasoactive intestinal peptide (VIP), substance P, and calcitonin gene related peptide (CGRP). All these factors could conceivably have an effect on tissue blood flow and interstitial fluid composition (29).

High levels of phospholipase A2 (PLA2),an important enzyme in the inflammatory process, were demonstrated in herniated nuclear material of patients with radicular pain (21). Cytokines interleukin-1a (IL-1a), IL-1b, IL-6, and tumour necrosis factor- α, particularly TNF α, induce synthesis of nitric oxide (NO), a potent mediator of inflammation (21). This inflammatory process seems to be exacerbated by the effects of nerve root pressure. Lumbo-sacral nerve roots, possibly due to the vulnerability of its venous drainage system, seem to be particularly susceptible to the effects of pressure. This may explain why even minor compression may lead to nerve root edema, intraneural inflammation and hypersensitivity (21).

The anatomic basis for discogenic and therefore vertebrogenic pain generated by all disc extrusions rests partially with somatic fibers originating from the recurrent meningeal nerve (sinuvertebral nerve of Luschka) supplying the posterior longitudinal ligament, the meninges, the blood vessels, the posterior extent of the outermost fibers of the annulus fibrosus, a portion of the periosteum of the vertebral bodies, and the underlying bone. In addition, a small branch from the ventral ramus of the somatic spinal nerve root directly innervates the posterolateral aspect of the vertebral body and related tissues for a variable distance. However, many of the afferent fibers of the anterior and anterolateral disc and paradiscal structures project immediately to the paraspinal sympathetic ganglia. Polymodal afferent pain fibers to the sympathetic ganglia have been identified in all of the anterior vertebral structures except the nucleus pulposus to include the anterior longitudinal ligament, the most peripheral laminae of the annulus fibrosus, the periosteum of the vertebral body, and the vertebral body itself. There is also a major autonomic branch extending posteriorly from the sympathetic ganglion or gray ramus communicans to join the recurrent

meningeal nerve. Thus, the entire disc periphery, and indeed the whole vertebral column, is supplied with afferent sympathetic fibers of the paravertebral autonomic neural plexus. Some of these afferent fibers traverse the sympathetic ganglia and enter the ventral ramus of the somatic spinal nerve via the white ramus communicans. Subsequently, these fibers pass into the dorsal root ganglion where the cell bodies lie. The dorsal root then carries the fibers as they enter the dorsolateral aspect of the spinal cord within the tract of Lissauer, adjacent to the dorsal horn gray matter (24).

Moderate pressure to the dorsal root ganglion activates both the type A and type C fibres. It has been hypothesized that the high sensitivity of the ganglion to mechanical compression is due to the high concentration of the sodium channels in the axon hillock area adjacent to the nerve cell body (30). The ganglion cells are rich in neurotransmitters like substance–P, calcitonin gene related peptide and somatostatin. The various mechanisms postulated for dorsal root ganglion stimulation are-

1) mechanical compression by the disc prolapse, osteophyte or facet joint,
2) exposure to nucleus pulposus and phospholipase A2 causing chemical stimulation,
3) after discharges from the ganglion cells long after the initial stimulus is removed
4) cross-excitation of the other neurons in the ganglion causing sustained paresthesias and pain.
5) vibration and other modalities causing cyclical excitation of the ganglion cells.

All of these can cause long term excitatory discharges into the dorsal horn of the spinal cord which in turn leads to neuroplastic changes and long term sensitization and excitability of the dorsal horn cells. The sensitized dorsal horn neurons may then relay along the pain pathways not only through the nociceptive (type A δ and C) fibers but also through the proprioceptive fibers(type A β) (30).

The absence of a clear compression of the nerve root is not exceptional. Moreover, it has been shown that in patients operated on for lumbar disc herniation, the pressures on the nerve root exerted

by the disc range from 7 to 256 mmHg(31). The pressure level and the duration of compression, as well as the time of onset for the compression, appear to be important factors.

Referred pain is diffuse, deep, dull, aching, nonspecific pain perceived in the referred pain "zones of Head," which are based loosely on the concept of "somatomes". These effects are not precise, and the referral patterns are rarely completely homosegmental, but instead spread over one or several contiguous segments. The entire perception of referred pain is handled within the autonomic (sympathetic) somatotopic organization of the CNS running in parallel with somatic afferent fibers (24). Lewis (1942) believed that referred pain from the deep structures was due to localisation to the skin by the cerebrum of all impulses from the particular nerve fibre. This concept of referred pain suggests how a lesion of the connective tissue, muscle, or even of bone, may produce pain of the same distribution as that from nerve root pressure (32).

Sciatica has high direct and indirect costs. Most of these costs are not generated by medical treatment but are attributed to loss of productivity.

Back pain

Low-back pain may be generated from all types of spinal tissue that contain free nerve endings (nociceptors). Free nerve endings have been demonstrated to be present in facet joints, discs, ligaments, nerve roots, and muscles(3). A large number of inflammatory and signaling substances have been suggested to play a role in back pain. Substance P, calcitonin gene-related peptide, and vasoactive intestinal polypeptide immunoreactive nerve fibers are present in the absolute outer layers of the annulus fibrosus of a normal disc. In patients with sciatica caused by disc herniation, reports of low-back pain preceding the sciatic pain are common. It has been suggested that this pain may be caused by the stimulation of nerve endings in the annulus fibrosus as a result of annular tear. Proinflammatory factors, which include cytokines (e.g., tumor necrosis factor and various interleukins), have been demonstrated to be present in disc herniation tissue and also in cell culture

of nucleus pulposus cells. However, disc degeneration can occur in the absence of back pain or any other symptoms.

Straight Leg Raising Test

The main component in the diagnosis of sciatica caused by disc herniation is the history. Few physical signs add useful additional information or result in alteration of a diagnosis made on the basis of the history (33). Mixter and Barr in 1941 wrote that "There is no easy road to correct diagnosis which can supplant the time honored method of careful history taking, complete physical examination, and the evaluation of that information in the light of appropriate laboratory tests" (34). Patients who, based on the results of physical examination, have a high likelihood of radiculopathy due to disc herniation may be better candidates for surgery (35).

The SLRT is commonly used as an aid to the diagnosis of low back pain (18). Historically, the SLRT was described by Lasègue's pupil Frost and subsequently reported in further detail by Lazarevic (36). Frost was the first to describe the SLRT in his Paris medical thesis of 1881(36).

Frost thought that the limiting mechanism was hamstring tension, whereas contemporaries, Lazarevic et al in 1880 and de Beurmann in 1884, favored sciatic nerve stretch. Since Mixter and Barr in1934, it has been thought that a causal link exists between intervertebral disc protrusion (herniation of the annulus and protrusion of the pulposus) and sciatic pain (17). Mixter and Barr (1934), Bradford and Spurling (1941), Charnlev (1951) and others have emphasized that the SLRT is the most informative clinical sign in the diagnosis of extruded intervertebral discs and in assessing progress after non-operative treatment (32).

The original description by Frost had 2 parts to the test. The second part wherein, the symptoms were again reproduced but only when the leg was extended at the knee; became known as the Lasègue's test. The Lasègue's sign was described as the reproduction of pain distal to the knee in the affected leg during the Lasègue's test.

The SLRT is a most important tool in evaluating patients with lumbar radicular leg pain (18). The vast majority of patients with paramedian lumbar disc herniation have a positive SLRT, whereas patients with far-lateral herniation less commonly have a positive test. A correlation between the SLRT and the patient's level of pain as well as the test's potential postoperative prognostic value has been demonstrated. The SLRT, has a high sensitivity and a low specificity (16, 17, 36) .

Root tension signs such as the SLRT are very common in disc herniation but are significantly less frequent in spinal stenosis (37). Most authors have suggested that compression of the nerve root was the most likely cause of pain during the SLRT. The sciatic nerve root, they had suggested, being relatively fixed between the dura and the intervertebral foramen, was unable to move away from a disc protrusion, and the ensuing compression and induced traction generated pain. The direction of nerve root movement was reported as caudal but also lateral toward the pedicle, and so toward any posterolateral LDH. It was also noted that the dura moved less than the intrathecal nerve root at the pedicle and experienced more strain, implying that the dura may be a contributor to the reproduced pain(17). The L4 and L5 intervertebral foramina are longer and narrower than the others, giving greater chance of pressure between discs and bone (38).

This test is usually positive in patients with disc protrusion at either of the last two intervertebral spaces, negative or slightly positive in L3L4 protrusions and negative when the protrusion is higher (38). The effect of the SLRT on the sciatic nerve was greatest at L5–S2 at 60° to 80°, but it was rarely seen at L3 or above. The greatest movement, 4 to 5 mm, was reported at the S1 nerve root, with 3 mm at the L5 nerve root, but decreasing with age, possibly because of increasing adhesions between the sciatic nerve and surrounding tissues (17).

However, lately various other mechanisms for a positive SLRT have been postulated. Stretching of both the dura, nerve root edema, nerve root irritation, and intervertebral foramen venous obstruction, a restriction of nerve root movement in the intervertebral foramens, damage to related ligamentous structures and collateral creation of an inflammatory focus over the dural cuff of

the nerve, a nonspecific stretching of the sciatic nerve, disc herniation initiated chemical irritation of the nerve root and the result of a protective hamstring reflex (17, 18, 36).

Patient and physician positions and action carried out

The sequence for performing the SLRT is:

- A firm, level couch with a supine, relaxed patient, neck in neutral position
- Patient's trunk and hips without lateral flexion or rotation, hips neither adducted nor abducted
- The physician stands by the affected side of the patient, ensuring that patient's knee remains extended, with the foot in a vertical plane, supports the affected leg at the heel and gently elevates the limb, placing the other hand over the knee of the affected lower limb.

The physician then flexes the affected straight leg on the hip until the patient's pain was reproduced. The angle of leg elevation at pain onset and site of that pain is recorded. Some then lower the limb until the pain diminishes and dorsiflex the foot to ascertain if the pain returns (17-19). The reproduction of back pain only or thigh pain (not extending distal to the knee) is considered a negative test (36). The angle of the positive SLRT is measured using a goniometer (15).

An alternative practice method to assess for acute lumbar radiculopathy has been to perform the SLRT in the seated position by extending the patient's knee and assessing for the reproduction of symptoms (36). The leg extension is stopped when the patient complains of the reproduction of symptoms distal to the knee joint or full extension is obtained. The examiner then lowers the patient's leg until symptoms are diminished or completely abolished. The procedure is performed first on the noninvolved leg and then repeated on the involved leg (36). The sensitivity (95%CI) of the seated SLR test was at 0.41 (95%CI, .29-.55) which was considerably lower than the supine SLRT (36).

Identifying a positive SLRT

A positive SLRT is recognized as a reproduction of pain in the affected limb and appropriate nerve root distribution (generally L4,L5,or S1), during leg elevation(36). If the SLRT is unilaterally limited, induces unilateral symptoms, or is bilaterally limited to less than 50°, then, for each leg, raise to onset of pain, lower a few degrees (to reduce pain), then successively dorsiflex the ankle, medially rotate the hip, and flex the neck (17, 18).

Symptom reproduction by one of these tests would be interpreted as a positive outcome, suggesting increased root tension, with the site of the pain suggesting the cause (17, 18). The addition of ankle dorsiflexion decreased the range of the SLRT, but the addition of cervical flexion had little further effect. Slater suggested that plantar flexion added to the SLRT stressed the common peroneal nerve, potentially aiding differential diagnosis of common peroneal nerve problems. He also suggested that medial hip rotation may "selectively increase tension"(17).

The posterior tibial nerve sign helps to eliminate the false positive that may sometimes be observed in cases of referred pain unassociated with nerve root pressure (32). While doing the passive SLRT when the limb has been raised to the point when pain is produced, the knee is flexed about 20 degrees and the limb is then raised further, to a point just short of that which again causes pain. Firm pressure applied to the middle of the popliteal space, over the posterior tibial nerve causes sharp pain in the lower lumbar region or in the affected buttock (32).

For the femoral nerve stretch test (FNST) the patient lies prone and the knee is passively flexed to the thigh; the test is positive if the patient experiences anterior thigh pain. This test is usually strongly positive in patients with protrusions at L2/3 and L3/4, slightly positive or negative in L4/5 protrusions and negative in cases with a lumbosacral protrusion. When sciatica is induced by the FNST, movement of the L4 root pulls on the L5 root which is inflamed and already tense. Therefore, in patients with suspected L4/5 disc protrusion, the induction of sciatica during the FNST is diagnostic (38).

The interpretation of the degree at which SLRT is positive is not clear with some studies suggesting a less than 40 degree being suggestive of a disc prolapse while other studies suggest 60 degrees (18).

Severe restriction of SLRT has been described as characteristic of lumbar disc herniation in teenage patients, but it is not clear whether this is due to a different mechanism from that in adults. The differing reports may be because of lack of discrimination between sciatic pain and hamstring tightness, both of which are often present to some extent (39).

Sprangfort (1971) reported that the incidence of restricted straight-leg raising decreases with age, and postulated increased tension on the neural tissues in children. Specific hamstring tightness may be related to the stretching of elements of the cauda equina during the rapid growth period in children. Isolated hamstring tightness did not appear to be caused by the same pathogenic mechanism as sciatica, and investigation should discriminate between the two sets of symptoms (39). Straight leg raising was less restricted in patients without herniations of the nucleus pulposus as compared with those with herniation. Patients with herniations of the nucleus pulposus had a significantly greater degree of restriction in the affected leg (40). Intraoperative straight-leg-raising reduces the blood flow in the nerve. Absence of SLRT limitation does not, however, preclude the presence of a herniated lumbar disc (22).

A positive preoperative SLRT was found to correlate to the neurologic deficit but not to the postoperative recovery(17). However, there was a strong correlation between a positive SLRT at 4 months after surgery and re-operation with a poor prognosis, being poorer for females than males. A negative SLRT at the 4-month postoperative point predicted an excellent prognosis (19).

Deyo et al and Andersson and Deyo (17) had quoted a sensitivity for the PSLR of 0.818(72–97%) (sensitivity meaning a negative result rules out the disorder) and a specificity of 0.418 (11–66%) (specificity meaning a positive result rules in the disorder). This suggested that a negative result was diagnostically more important than a positive one (17, 36).

The diagnostic accuracy of the SLRT in detecting disc hernia seems to be limited by its low specificity(17). Although the sensitivity is high, the diagnostic odds ratio remains low as the probability of a positive in surgical patients without a disc hernia remains high. This results also in a high prevalence (a test cannot cause a high prevalence) and, consequently, in a high predictive value of a positive SLRT (16).

Considerable improvements in the inter- and intra-observer reliability could be gained by using biomechanical devices, which standardized procedures, thus reducing the influence of differing settings, individual observers, and patients (17). Miller et al reported that by age 50, 97 % of lumbar discs showed signs of degeneration and that this degeneration was already manifest in the age range of 11 to 19 years for males, and a decade later for females, implying that age may be an important limiting factor for the SLRT (17).

The test for crossed SLRT (CSLRT) is similar to the passive SLRT, except the contralateral leg is elevated and the test is positive when the sciatica is reproduced in the ipsilateral leg (15). The pooled sensitivity was 0.29 (95% CI 0.24–0.34), and the pooled specificity was 0.88 (95% CI 0.86–0.90) (16). The increased specificity results in a slightly higher positive predictive value. If the CSLRT would be used as a confirmatory test in patients with a positive SLRT, the predictive value of a positive test would increase upto 0.94 (16).

Treatment Options

Nonsurgical

Most patients with acute sciatic neuralgia respond to conservative symptomatic management and resolve over a period of weeks to months. However, some do not and require surgery. Approximately 10 – 40 % develop into chronic pain syndrome (21, 41).

Conservative treatment for sciatica is primarily aimed at pain reduction, either by analgesics or by reducing pressure on the nerve root (42). The initial phase of sciatica frequently responds to conservative management. Overall, 70 % of patients treated with 1 week bed rest followed by simple analgesia reported a marked reduction in back and leg pain and improved functionality within 4 weeks and 60 % had returned to work. After 1 year, 32% had ongoing problems that still restricted work and leisure activities. A previous history of sciatica was the only risk factor identified with a poor outcome (10, 21, 42). For 90 percent of patients with lumbar disc herniation (LDH), acute sciatica starts to improve within six weeks and resolves by 12 weeks with conservative care (10).

No imaging is needed before 6 weeks of conservative trial for patients who are clinically diagnosed with a LDH unless one of the red flags is discovered. If this is the case, then further workup is warranted before the 4 to 6 week observational period (22).

Patients who are not surgical candidates or who decide to continue conservative management should expect their clinical improvement to be slower than for patients who undergo surgery (43).

Several nonsurgical treatments have proven effective in improving symptoms of lumbar disc herniation and should be considered first-line in the first six weeks of conservative management(22).

Bed rest places the least amount of pressure on the intervertebral disc and has, therefore, led many practitioners to recommend patients initially remain in a supine position for a specified period of time. However, there are no prospective randomized studies describing the efficacy of bed rest or the appropriate duration(22). Bed rest is less effective for sciatica than activity and little difference in effect on pain and functional status has been shown between bed rest and advice on staying active. In general, bed rest should be limited to avoid muscle deconditioning. As a result of this finding, bed rest for a long time, the mainstay of treatment for sciatica, is no longer widely recommended (42, 43). Studies which compared bed rest with a formal physiotherapy and education program for patients with an acute episode of LBP found no beneficial effect of either treatment with regards to

several clinical outcome measures, including straight leg raising, lumbar flexion, activities of daily living, and pain (22).

There are no studies that show lumbar supports are more effective than other interventions for treatment of LBP (22).

Several medications have been used to treat lumbar disc herniations pain. Nonsteroidal anti-infammatory drugs (NSAIDs), paracetamol, and muscle relaxants have been shown to be effective in the treatment of nonspecific low back pain, but these therapies have not been shown to be better than placebo in lumbar disc herniation pain (42, 43).

No specific NSAID was shown to be more efficacious than another (22). No difference in efficacy between benzodiazepines, non benzodiazepines, and antispasticity muscle relaxants was found (22).

Systemic corticosteroids are no better than placebo for lumbar disc herniation pain and have no role in conservative management. Opioid analgesics have not been studied for lumbar disc herniation pain, but are generally considered standard conservative therapy for patients with severe, function limiting pain (42, 43).

Physical therapy typically has had a role in conservative management of lumbar disc herniation, although best evidence suggests there is little to support its effectiveness for improving pain or functional status (43). Early active physical therapy (exercises) seemed not to be better than inactive (bed rest) treatment and other conservative treatments, such as traction, manipulation, hot packs, or corsets (22, 42). However physical therapy not only reduces pain but it also limits days off from work (22). Cost-effectiveness analysis concludes that physical therapy and multimodal rehabilitation is no more cost-effective than usual conservative management without physical therapy(22).

Directional preference therapy where flexion or extension is limited depending on the cause for pain and direction for pain relief has been shown to be superior to non-directional therapy and

placebo. These results, however, diminish in the long term with no difference found at 5 years when comparing a directional protocol (McKenzie method) with education in back school (22).

The effectiveness of physical therapy modalities, including therapeutic ultrasound, transcutaneous electrical nerve stimulation (TENS), and traction is difficult to assess because of limited studies. Therapeutic ultrasound and TENS may provide short-term benefit, but data on traction are conflicting, with recent systematic reviews concluding that traction is not effective (43). Patients who experienced pain relief during the actual traction were slightly more likely to avoid surgery (22).

Studies evaluating spinal manipulation for lumbar disc herniation have had conflicting results. Meta-analyses have found no benefit of manipulation over other conservative therapies. A subsequent study comparing manipulation with sham manipulation found that manipulation significantly improved pain(43). Massage was shown to be effective for persistent back pain and may have a role in treatment cost reduction (22).

Acupuncture has become a popular alternative for the treatment of LBP and LDH. However, no definitive studies have been done that indicate a clear benefit of its use as a sole treatment or as an adjunct (22).

Cognitive interventions involve educating the patient to stay active and avoid activities that could worsen the pain (43). No difference in disability outcomes were shown after one year of treatment; however, less fear and fewer avoidance behaviors were noted in patients given cognitive intervention (43).

In a prospective study, patients with disc herniation or annular bulging diagnosed by CT, had a second CT one year later after one or more epidural injections of steroids. Of the patients with disc herniation, 76% showed a decrease in size, with one-fifth of those demonstrating disappearance of the protrusion, on control CT scans. Only 29% of patients with a bulging annulus fibrosus showed such shrinkage. Deterioration was observed on CT scans in only four patients (5%) (10).

Repeat MRI scanning demonstrated that large disc herniations with migrating nucleus pulposus were more likely to resolve partially or completely than those herniations where nucleus pulposus was continuous with the main body of the nucleus, that is, disc protrusions. Clinical outcome was closely related to morphological changes on MRI and morphological changes tended to lag behind clinical improvement (10, 21).

One recent randomized control trial comparing prolonged conservative management with early microdiscectomy for lumbar disc herniation concluded that a longer course of conservative management before surgery (i.e., averaging more than 18 weeks) did not alter the incidence of adverse outcomes as a result of waiting longer before surgery (43).

The incidence of recurrences of radicular pain in the years after conservative treatment was 20% compared with 10% in patients undergoing operation (10). The lifetime prevalence for surgical intervention for LDH varies from 1% to 3% (22).

Nonsurgical Invasive Treatments

Epidural Steroid injections

Steroid injections into the epidural space or the herniated disc have been used to reduce inflammation. Epidural steroid injections may provide moderate short-term improvement of pain, but do not impact long-term outcomes, such as impairment of function, need for surgery, and pain after three months. There is fair evidence that injections done under radiologic guidance are more effective than injections without this guidance in terms of improving pain at intermediate follow-up, and disability at short-term and intermediate follow-up (43).

Epidural steroid injection was successful in about 1⁄2 the patients prospectively randomized to receive them who had not responded to an initial 6-week period of nonoperative care for LDH. The treatment was effective for up to 3 years (22).

A study of intra-discal corticosteroid injections has not shown benefit over placebo for treatment of discogenic pain(43).

Patients who had a successful epidural steroid injection were twice as likely to have an extruded or sequestered disc as those in whom the injection failed (44).

Chemonucleolysis

Chemonucleolysis is a procedure involving percutaneous injection of a substance into the disc to digest and ablate herniated disc material. It is a technically simple procedure for the L4/L5 and L5/S1 discs and has given the highest rate of satisfactory results of all the percutaneous procedures (10). Conversely, however, there is strong evidence that chemonucleolysis does not produce as good clinical outcomes as discectomy, even if that must be balanced against a lower overall complication rate (45).

Chymopapain, the papaya extract once used for this purpose, has been proven unsafe due to the danger of neural damage following accidental intradural injection, cerebrovascular accidents and also the probability of induction of malignant spinal tumours (42, 43, 46, 47). Nucleolysis with chymopapain should not be considered as a minor therapeutic procedure representing the last stage of conservative management (10). Concerns about its safety and controversy about its effectiveness led to it being withdrawn for a while by the U.S. Food and Drug Administration, but it was released in 1982. Its use is currently in decline (45). Intermediate and long-term success rates have been reported to be from 40 % to 90 %. The 12 year results reported by Parkinson (48) and the 3 to 6 year results reported by Javid et al (47), revealed 70% and 73% success rate respectively (47). No statistically significant differences were demonstrated between low-dose and standard-dose chymopapain, between chymopapain and collagenase, or between chymopapain and steroid injection (44). Chemonucleolysis was more effective than placebo (42, 45).

A Cochrane review reported better results with disc surgery than with chemonucleolysis in patients with severe sciatica of relatively long duration varying from more than four weeks to more than four months (42). Collagenase does not offer any significant advantages compared with chymopapain. The absence of major allergic reactions is balanced by a lower therapeutic efficacy and a comparable or higher rate of neurological complications. Enzymes still under investigation, such as chondroitinase ABC, cathepsins B and G and calpain I, do not appear to compete with chymopapain (10).

Percutaneous automated nucleotomy (PAN)

This is a simple technique at the L4/L5 and more cranial levels, but the L5/S1 disc may be difficult or impossible to approach. Infection of the disc is the only real complication, although, exceptionally, neurological damage has been reported. The ease of the technique and the low rate of complications made the procedure very attractive, until serious doubts arose concerning its therapeutic efficacy (10). Onik et al, the original proponent, suggested that the therapy was only suitable for small-sized herniations, strictly localized in front of the intervertebral space and without a tear of the posterior longitudinal ligament. Ideally, the disc herniation should not occupy more than 30% of the spinal canal (44).

Studies have not shown a significant improvement over placebo suggesting that PAN may not be truly effective, the successful outcomes being due in many cases to spontaneous resolution of the symptoms. Little is known concerning the mechanism of this technique and the few available studies suggest that PAN may increase rather than reduce the bulging of the disc in the spinal canal (10).

Endoscopic discectomy

Arthroscopic techniques have recently emerged as an alternative to microdiscectomy. Clinical results are similar to microdiscectomy, however, there is a slightly higher rate of retained disc material and

residual symptoms. The advantages are less operative time, avoidance of general anesthesia, minimal blood loss, and less scarring in the spinal canal (22).

Manual percutaneous discectomy (PD) and endoscopic percutaneous discectomy (PED)

PD usually allows removal of the nucleus pulposus to a similar extent as PED and the results are comparable with those obtained by endoscopic discectomy. The endoscope, however, enables the operator to check the completeness of the discectomy, particularly in the posterior portion of the disc and should be preferred(10). A trial compared PED with microdiscectomy and showed comparable clinical outcomes after the 2 procedures but the study group of 40 patients was small (44). A few clinical trials support the impression that removal of the nucleus pulposus under endoscopic control can lead to a clinical success rate of about 70% in patients with a contained or small extruded herniation, but if one considers that patients in these circumstances often undergo a spontaneous resolution of the clinical symptoms, PED seems to be an adequate procedure in less than 15% of patients needing surgery (10).

Laser discectomy

Numerous experimental studies indicate that various laser systems are able to coagulate, shrink, carbonise, vaporize or ablate the nucleus pulposus, but only a few have been used for clinical purposes. In endoscopic disc surgery, the laser, if correctly used, appears to be as safe as manual instruments with no complications related to its use reported so far. Flexible forceps for manual discectomy, however, are as effective as the laser in the removal of the posterior portion of the nucleus pulposus. Moreover, the use of a laser does not reduce the operating time and is not technically simpler but the cost is considerably higher. The clinical results appear comparable with those obtained with manual or automated percutaneous discectomy (10). There was no significant difference demonstrated between the outcomes following laser use and that obtained after an

epidural steroid injection (44). At present, the laser appears to be a tool that is neither necessary nor particularly useful in endoscopic disc surgery, and this may explain why so far its use has been very limited (10). Hellinger compared the effects of a Nd-YAG-laser (1064nm) with that of a diode laser (940nm). Both produced only slight vaporization but excellent shrinkage of disc tissue (44).

Trials of automated percutaneous discectomy and laser discectomy suggest that clinical outcomes following treatment are at best fair and certainly worse than after microdiscectomy, although the importance of patient selection is acknowledged (45).

Ozone therapy

In oxygen-ozone therapy, ozone is administered percutaneously into the disc in the form of an oxygen-ozone gas mixture, at nontoxic concentrations. A reduction in herniated disc volume is one of the therapeutic aims of intradiscal administration of medical ozone, as disk shrinkage may reduce nerve root compression. Another reason for using medical ozone to treat disc herniation is its analgesic and anti-inflammatory effects (49). The pathological examination of these discs revealed dehydration of the fibrillary matrix of the nucleus pulposus, revealing collagen fibers and signs of regression (vacuole formation and fragmentation)—a sort of disc mummification (49).

Surgical

Walter Dandy described two cases on which he operated for low back and leg pain in 1929. He found cartilaginous fragments lying loose in the spinal canal simulating a spinal tumour. Calve and Gallant (cited by Postaccini) in1930, reported 24 patients with low back pain and sciatica in whom a disc herniation had been found at surgery.

In1933, Mixter and Barr presented a paper, ‘Rupture of the Intervertebral Disc with Involvement of the Spinal Canal’ to the New England Surgical Society. This paper, published in

1934 in the New England Journal of Medicine, was highly influential and opened the era of surgery for disorders of the intervertebral lumbar disc (20, 50). Mixter was generally credited by his contemporaries as being the man who best clarified the relation between the intervertebral disc and sciatica (20, 21). There after surgery was widely used, many variations of the techniques have developed, sometimes without full appreciation of the natural history of the symptomatology, and the intractability of operative failures (20).

McCulloch stated that there are eight basic principles that the surgeon and the patient should understand when operative treatment is recommended:

(1) LDHs are common (1% of the total population);

(2) more than 90 % have some improvement with non-operative treatment;

(3) 2 % to 4 % of patients with LDHs are surgical candidates;

(4) MRI will reveal a LDH in approximately 20 % to 30 % of asymptomatic patients younger than 60 years of age;

(5) surgical intervention will improve short-term outcomes, but long-term studies show little difference with those treated non operatively;

(6) surgical intervention rarely is indicated before 6 weeks from the onset of symptoms but should not be delayed to beyond 3 to 4 months;

(7) the disc will continue to degenerate with either form of treatment; and

(8) scar tissue will form, possibly creating a poorer prognosis in the future if repeated discectomy is required (22).

Surgical intervention for sciatica focuses on removal of disc herniation and eventually part of the disc or foraminal stenosis. Treatment is aimed at easing the leg pain and corresponding symptoms and not at reducing the back pain. Consensus is that a cauda equine syndrome and progressive neurological deficits are an absolute indication for immediate surgery (22, 42).

Indications for surgery according to the American Association of Orthopaedic Surgeons' criteria are

1: functional incapacitating pain in the leg extending below the knee with nerve root distribution;

2: nerve root tension signs (positive SLRT result), with or without neurologic abnormalities, fitting the radiculopathy;

3: absence of clinical improvement after conservative treatment; and

4: a confirming imaging study that correlated with the physical signs and distribution of pain (51).

A herniation into an already stenotic spinal canal and large extruded fragments are other suggested indications (22).

A systematic review and a recent large randomized controlled trial (RCT) show that surgical discectomy in carefully selected patients with sciatica from lumbar disc herniation provided faster relief of pain and disability than patients who were treated with conservative management (43-45). Surgery has been shown to have greater improvement in pain and disability than conservative treatment in the first two years after surgery, after which the outcomes are no different (43).

In the SPORT randomized trial (n=501) both treatment groups improved substantially over two years for all primary and secondary outcome measures. Small differences were found in favour of the surgery group, but these were not statistically significant for the primary outcome measures (42). The SPORT observational cohort included 743 patients and both groups improved substantially overtime, but the surgery group showed significantly better results for pain and function compared with the conservative group (42).

The optimal timing for surgery is still unclear, but most surgical studies have followed a minimum six-week trial of conservative therapy before surgical intervention (42, 43).

A Cochrane review further concluded that the long term effects of surgical intervention are unclear (42). The medium-term clinical outcomes have been sufficiently consistent for discectomy to survive the test of time in widespread clinical practice for more than 60 years (45).

The clinical outcomes of microdiscectomy are comparable to those of standard discectomy. In principle, the microscope provides better illumination and facilitates teaching. These trials suggest that use of the microscope lengthens the operative procedure, but despite previous concerns, they did not show any significant difference in perioperative bleeding, length of in-patient stay, or the formation of scar tissue (45).

The choice of micro-or standard discectomy at present probably depends more on the training and expertise of the surgeon, and the resources available, than on scientific evidence of efficacy (45).

One trial compared early outcomes and recurrence rates after sequestrectomy and microdiscectomy. There was a trend toward better outcome and a lesser rate of secondary surgery after sequestrectomy alone than after removal of the herniated material and resection of disc tissue from the intervertebral space (44).

Minimally invasive techniques such as tubular discectomy have been introduced to speed up recovery. Patients were expected to mobilize more quickly due to reduced post-operative pain associated with the muscle-splitting technique and, consequently, minimally invasive surgery would lead to better results in the short term. However, patients reported that they were fully recovered after a median period of 2 weeks, irrespective of the assigned surgical treatment. Studies revealed that the rates of recovery for the minimally invasive tubular discectomy and conventional microdiscectomy were similar. In contrast, the overall differences in pain intensity and recovery rates favored the conventional microdiscectomy approach (52).

Common complications include wrong level surgery, missed pathology and/or retained disc, durotomy, epidural venous bleeding, lesions from positioning, residual back and/or leg symptoms, recurrent disc herniation, cauda equina, epidural hematoma, infection, discitis, iatrogenic instability, thromboembolism, and postoperative epidural fibrosis and/or arachnoiditis (22)

Spinal surgery done at the wrong level can be prevented with an intraoperative x-ray that marks the exact vertebral level (site) of surgery (22).

Inadvertent durotomies occurred in 0.8 % to 7.2 % in different series. Nerve root lesions occurred on average 0.2 % of the time. Infections occur in 2 % to 3 % of all cases across the board. A review of the literature indicates that recurrent herniations occur with a frequency of 5 % to 15 %, with the risk decreasing overtime (22, 41). Lack of physical activity is a significant risk factor for recurrence (22).

Since Weber's landmark findings there has been a trend towards nonoperative treatment. Postachinni summarized it well when he stated: "In the last two decades, we have shifted from an aggressive surgical approach for the treatment of patients with a herniated disc to an excess of nonoperative management, passing through chemonucleolysis and the various methods of percutaneous discectomy, which have clearly shown their limits. In the next decade, we must reach a new equilibrium between nonoperative and operative treatment. We should better understand which patients are likely to obtain full and satisfactory results in a reasonably short period after nonoperative care; which are the few candidates for the various percutaneous modalities of discectomy; which are the patients in whom surgery, done with minimally invasive techniques, is the treatment of choice in terms of clinical efficacy and rapidity of return to activities of daily living; and which can be better treated with a fusion or a disc prosthesis because of chronic back pain related to the herniated disc." (22).

Factors predicting outcomes:

The following baseline characteristics were associated with poor outcomes: younger age, lower satisfaction with work, depression, previous treatment for back pain, pain below the knee, more severe symptoms, and greater back-related worry. Among the variables not related to a poor outcome were gender, education, physically demanding job, general health perceptions, Chronic Pain Grade score, duration of current episode, and baseline Roland Disability score (12, 53). When the multivariate analyses were restricted to the subset of patients who were working, satisfaction with

work was found to be significant, but age was no longer significant (53). The age of the patient appeared to influence the results of surgery in only two ways: convalescence was moderately prolonged in patients over 50 years of age, and those in this age group had more residual backache than younger subjects. There was no notable difference in results from the standpoint of sex (54, 55). Disc herniations at the L5–S1 level had significantly greater improvements in both mean VAS leg and Oswestry outcome scores than disc herniations at the L4–L5 level (56). Preoperative scoliosis had no association with walking capacity, symptom severity, or satisfaction (55, 57).

Studies have shown that a long preoperative duration of sciatica and long preoperative duration of time absent from work had significant negative influence on the surgery related outcome (9, 19, 56, 58). The duration of leg pain can be used to predict outcome after surgery, after 8 months of leg pain, there may be increased risk of a poor clinical result (58). Patients with preoperative preponderance of radicular leg pain versus back pain had better surgical outcomes (56). The response to initial nonoperative treatment was a statistically significant factor for a good prognosis (59).

A positive preoperative SLRT was found to correlate to the neurologic deficit but not to the postoperative recovery(17). There was a strong correlation between a positive SLRT at 4 months after surgery and re-operation with a poor prognosis, being poorer for females than males. A negative SLRT at the 4-month postoperative point predicted an excellent prognosis (19).

Poorer surgical outcomes have been reported in patients with massive annular defects and those with an intact annulus and no identifiable fragment (56). Patients with sequestered disc fragments had significantly greater improvements in both mean VAS leg and Oswestry outcome scores than extruded or contained disc types. Contained discs were associated with the poorest outcomes (56). Dural tube cross-sectional area $>70mm^2$ in magnetic resonance imaging was associated with better postoperative Oswestry score compared with patients having cross-sectional area $<70mm^2$ (57).

Smoking showed no statistically significant impact on any outcome measure with the exception of return to duty (56).

The longer the follow-up, the less important is the influence of neurological recovery on the patient's assessment of their quality of life (60).

Approximately 15% of patients who have surgery after an adequate trial of nonoperative treatment show no improvement, while the majority of patients experience significant relief of LBP. Patient's age, type of disc herniation, recurrence, and need for reoperation are significantly related to the patient's satisfaction with the outcome of surgery (22).

Satisfaction was not found to depend on the interval between clinical onset and diagnosis or on the timing of surgery (22). The degree of return to activities of daily living (ADL) was found to be significantly related to age, need for re-operation, type of disc herniation, and timing of surgery (22). The age and type of disc herniation are important to consider when deciding whether to operate on a patient and that return to ADL postoperatively correlated with disc disease recurrence (22).

Patients with an extruded herniated disc had a shorter duration of symptoms and a better functional outcome than those with a contained herniation. Patients with sciatica for more than 12 months have a less favorable outcome, and there was no difference in outcomes for surgical patients in whom the duration was less than 12 months. In another study, investigators looked at the risk of "getting worse." Using the Oswestry disability index as their measure, they found that 4% of patients deteriorated. Independent risk factors of deterioration were along duration of sick leave and a better functional status and quality of life prior to operation (22).

Measures of Outcome

There is no consensus regarding the best method of assessing pain outcomes in spine patients. Pain intensity, recorded on a visual analog scale (VAS), is one of the most used measures (61). VAS

enables an immediate graphic representation of pain results over time and fulfils well the needs of longitudinal outcomes assessment (61).

The SF-36, ODI, LBOS, MSPQ, and MZ have all been shown to have good validity, reliability, and acceptability in patients with spinal problems (62). Using the ODI as a predictor of health state may reduce respondent and administrative burden, particularly in an institutional or clinical setting, The ODI is widely used and validated and the score is determined using a specific questionnaire and scoring algorithm (63).

The primary outcome measures in the SPORT trial were the Short Form-36 bodily pain and physical function scales and the Oswestry Disability Index. The SPORT observational cohort suggest that differences in the Oswestry Disability Index and SF-36 pain and physical function scores between medically and surgically treated patients diminished but remained significant at 2 years (64).

Ostelo et al, reviewed the published data on change scores using several low back questionnaires including the Oswestry Disability Index, and showed that questionnaires with scores ranging from 0 to 100 had a meaningful absolute change score between10 to 20 points (65).

In November 2006, the multicenter U.S. Spine Patient Outcomes Research Trial (SPORT) was published which compared standard open discectomy with nonoperative treatment individualized to the patient. A total of 1,244 patients were enrolled; 743 in the observational cohort study and 501 in the randomized trial. Primary outcomes were changes from baseline in the 36-item Short Form bodily pain and physical function scales and modified Oswestry Disability Index. However it noted that conclusions about the superiority or equivalence of the treatments under study were not warranted based on the intent-to-treat analysis (45, 64, 66). Reasonable estimates for the minimal clinically important difference for the scales used in SPORT were 10 points for the SF-36 subscales, and 8 to 12 points for the ODI (67).

MATERIALS AND METHODS

STUDY DESIGN

A prospective longitudinal design was used to document the change in the leg pain (VAS) and functional outcome of the patients with a positive preoperative passive SLRT who underwent surgery for lumbar intervertebral disc prolapse. The assessments were done preoperatively, seven days postoperatively and by a postal questionnaire after 6 months and 1 year.

STUDY SETTING

The study was conducted in the Department of Neurological Sciences, CMC Hospital Vellore, Tamil Nadu, India. All patients diagnosed to have a lumbar intervertebral disc prolapse on clinical examination and on lumbosacral spine MRI and planned for surgery were screened.

SAMPLE SIZE

The sample size for the study was calculated using the formula –

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{(F_{Z\rho 1} - F_{Z\rho 0})^2} + 3 = 130$$

$$F_{Z\rho 1} = \tfrac{1}{2}\eta \left\{ \frac{1+\rho_1}{1-\rho_1} \right\}$$

$$F_{Z\rho 0} = \tfrac{1}{2}\eta \left\{ \frac{1+\rho_0}{1-\rho_0} \right\}$$

Assuming a correlation coefficient χ of 0.3, α error of 5 %, power (1-β) of 80%. The sample size was calculated to be 130 with an adjustment for a dropout rate of 33.33%.

CRITERIA FOR PATIENT SELECTION

INCLUSION CRITERIA: All patients with lumbar intervertebral disc prolapse with a positive SLRT undergoing discoidectomy.

EXCLUSION CRITERIA:

- Patients with any previous surgery of the lumbar spine.
- Patients undergoing fusion procedures (TLIF, PLIF etc.)

PREOPERATIVE PATIENT EVALUATION

Patients were examined preoperatively (1-2 days before their surgery) and the degree of passive SLRT, leg pain on the VAS and functional status by the revised Oswestry disability index (ODI) and Macnab's criteria were recorded on a proforma (annexure 1).

METHOD FOR DETERMINING DEGREE OF SLRT

Patient was made to lie down supine on a firm, level couch with the neck in neutral position. The patient was explained the procedure and asked to relax. Standing by the affected side of the patient, ensuring that patient's knee remains extended, with the foot in a vertical plane, the affected leg was held at the heel and gently the limb was elevated. The affected straight leg was passively flexed on the hip until the patient's leg pain was reproduced.

The angle of leg elevation at pain onset and site of that pain was recorded. The angle of the positive passive SLRT was measured with a goniometer.

FIGURE 1: Goniometer

An assistant held the leg elevated at the degree where the leg pain was reproduced, while the degree of hip flexion was measured by keeping the goniometer centered at the greater trochanter of the femur, with one limb of the goniometer kept parallel to the flat couch and the other along the lateral aspect of the thigh.

FIGURE 2: Bedside measurement of the degree of SLRT with a goniometer

POSTOPERATIVE AND FOLLOW UP EVALUATION

All patients underwent a re-examination on the seventh postoperative day when their degree of SLRT and leg pain on the VAS was recorded.

Change in SLRT was categorized as =/<30 and > 30 degrees.

Patients were then followed up using a postal questionnaire (annexure 2) at 6 months and 1 year post surgery and their leg pain on the VAS and functional outcome on the revised ODI score and Macnab's criteria were calculated. All patients were asked to come for a review at 1 year and their outcomes in terms of the leg and back pain VAS, Macnab's grade and the revised ODI were collected.

DEFINITION OF CHANGE

- Change in degree of SLRT : >30 OR </=30 degrees
- Change in PAIN VAS > 3 OR </=3 points
- Change in ODI score </=50 OR >50 %

PATIENT MATERIAL

A total of 216 patients were recruited into the study. 6 month follow-up was available for 188 patients and 1 year follow up for 179 patients. There were 128 males and 60 females with ages ranging from 17 to 62 years (mean age of 50 years). The level of disc herniation was L2/L3 in 5 patients, L3/L4 in 9, L4/L5 in 108 and L5/S1 in 66 patients.

STATISTICAL ANALYSIS

Correlation between degree of change in SLRT at 7 days and the improvement in leg pain VAS and change in the ODI scores and improvement in the Macnab's scale at 6 months and 1 year was calculated.

The statistical analysis was done using the Pearson Chi square test on the STATA 10.0 (StataCorp, College station, Texas USA).

A p value of < 0.05 was taken as significant.

Both univariate and multivariate analysis was done. For univariate analysis the independent variables were :

1. Age (< = 40; > 40 years)
2. Sex (m, f)
3. Total duration of leg pain preop (the total duration of leg pain including all the episodes of leg pain including the present) (< =2 month; >2 month)
4. Duration of last episode of pain preop (< = 4 weeks ; >4 weeks) – (this is the duration of the last episode of leg pain only)
5. Preoperative degrees of SLRT (>/= 60 vs <60 degrees)
6. Level of surgery (L4L5 &L5S1 vs Others)
7. Change in SLRT at 1 week (</= 30 vs >30 degrees)
8. Leg pain VAS Change at 1 week (</= 3 vs >3 point change)
9. Type of disc prolapse (contained or extruded)

The dependent variables assessed were:

1. Leg pain VAS at 1 week, 6 months and 1 year
2. ODI scores at 6 months
3. MacNab's criteria at 6 months and 1 year

Multivariate analysis was using the following independent variables which were statistically significant on univariate analysis :

1. Duration of last episode of pain preop (< = 4 weeks ; >4 weeks)
2. Preoperative degrees of SLRT (> = 60 vs <60 degrees)
3. Level of surgery (L4L5 &L5S1 vs Others)

4. Change in SLRT at 1 week (<= 30 vs >30 degrees)

5. Leg pain VAS Change at 1 week (<= 3 vs >3 point change) (when the ODI score at 6 months and leg pain VAS and Macnab's scale were used as dependent variables at 6 months and 1 year)

The dependent variables assessed were the same as in univariate analysis.

HYPOTHESIS

Our hypothesis was that a more than 30 degree change in the passive SLRT in the early postoperative period (7 days postoperative) correlated with the long term improvement in leg pain and outcome of surgery and can be used to predict the outcome at 1 year.

A longer total duration of leg pain and a longer duration of the last episode of leg pain were also expected to be associated with a poorer outcome. Similarly a preoperative positive SLRT of < 60 degrees was expected to be associated with a better outcome for improvement in leg pain after discectomy. The L4-L5 and L5-S1levels were more commonly associated with lumbar disc prolapse, and extruded disc prolapses were associated with more acute leg pain and preoperative positive SLRT and were expected to have a better outcome post discectomy than central disc prolapse or prolapses at other levels.

RESULTS

A total of 216 patients were recruited into the study 6 month follow-up was available for 188 patients and 1 year follow up for 179 patients.

Predictors of change in leg pain VAS at 1 week and 1 year

TABLE 1: Univariate analysis of the change in leg pain (VAS) at 1 week as the dependent variable

Independent variables	Change in VAS at 1 week		P value
	</= 3	> 3	
Age >40 years <40 years	 16 14	 90 68	0.713
Sex M F	 9 21	 51 107	0.806
Total duration of leg pain < /=2 months > 2 months	 4 26	 23 135	0.861
Duration of last episode of pain </ = 4 weeks >4 weeks	 5 25	 114 44	0.000
Preoperative SLRT >/= 60 degrees < 60 degrees	 11 19	 4 154	0.000
Level of surgery L4L5&L5S1 Other levels	 29 1	 145 13	0.349
Type of disc prolapse Contained Extruded	 13 17	 95 63	0.088
Change in SLRT at 1 week </= 30 degrees >30 degrees	 14 16	 3 155	0.000

TABLE 2: Univariate analysis of change in leg pain (VAS) at 1 year as the dependent variable

Independent variables	Change in VAS at 1 year		P value
	</= 3	> 3	
Age			0.355
>40 years	12	89	
<40 years	6	72	
Sex			0.226
M	8	49	
F	10	112	
Total duration of leg pain			0.665
</=2 months	2	24	
> 2 months	16	137	
Duration of last episode of pain			0.000
< /= 4 weeks	3	111	
>4 weeks	15	50	
Preoperative SLRT			0.000
>/ = 60 degrees	8	7	
< 60 degrees	10	154	
Level of surgery L4L5&L5S1	17	149	0.769
Other levels	1	12	
Change in SLRT at 1 week			0.000
</= 30 degrees	10	7	
>30 degrees	8	154	
Change in leg pain VAS at 1 week			0.000
</= 3	17	11	
> 3	1	150	
Type of disc prolapse			0.528
Contained	9	93	
Extruded	9	68	

When the change in leg pain on VAS at 1 week was taken as a dependent variable, the chi-squared test showed the duration of the last episode of pain, preoperative positive degree of SLRT and change in the degree of SLRT at the seventh postoperative day to be significant on univariate analysis. The age, sex, total duration of leg pain or the level of surgery was not found to be statistically significant.

When the change in leg pain on VAS at 1 year was taken as a dependent variable, the chi- squared test showed the duration of the last episode of pain, preoperative positive degree of SLRT, change in the degree of SLRT at the seventh postoperative day and the VAS for change in leg pain at 1 week to be significant on univariate analysis. The age, sex, total duration of leg pain, type of disc prolapse or the level of surgery was not found to be statistically significant.

TABLE 3: Multivariate analysis of change in leg pain (VAS) at 1 year as the dependent variable

Variable	Odds ratio (95 % confidence interval)	P value
Duration of the last episode of leg pain	0.79 (0.12 - 5.04)	0.793
Preoperative degree of SLRT	0.96 (0.84 - 1.094)	0.516
Level of surgery	1.94(0.05 – 78.92)	0.726
Change in degree of SLRT at 7 days postoperative	1.39(0.18- 10.53)	0.750
Change in leg pain VAS at 7 days postoperative	82.96 (5.32 – 1292.51)	0.002

In multivariate analysis when the change in the change in the leg pain (VAS)at 1 year was taken as a dependent variable change in the leg pain (VAS) on the seventh postoperative day alone was found to be statistically significant. The duration of the last episode of leg pain, preoperative degree of SLRT, the level of surgery or the change in degree of SLRT at the seventh postoperative day were not found to be statistically significant on multivariate analysis

Predictors of ODI score at 6 months and 1 year

When the change in the revised ODI at 6 months was taken as a dependent variable the chi squared test showed the age, duration of the last episode of pain, preoperative positive degree of SLRT, change in the degree of SLRT at the seventh postoperative day and the VAS for change in leg pain at 1 week to be significant on univariate analysis. The sex, total duration of leg pain, type of disc prolapse and the level of surgery were not found to be statistically significant. When the revised ODI score was assessed it was found that at the end of 1 year all but 2 patients irrespective of their initial

symptoms had a >50 percent improvement. So while the independent variables were significant in detecting change in ODI at 6 months, they lost their significance at the end of 1 year and ~ 99% of the patients showed a > 50 % improvement.

TABLE 4: Univariate analysis of the change in the revised ODI score at 6 months as the dependent variable

Independent variables	Change in Revised ODI score at 6 months		P value
	</= 50	> 50	
Age			0.030
>40 years	14	92	
<40 years	21	61	
Sex			0.255
M	14	46	
F	21	107	
Total duration of leg pain			0.279
</ =2 months	3	24	
> 2 months	32	129	
Duration of last episode of pain			0.002
</ = 4 weeks	14	105	
>4 weeks	21	48	
Preoperative SLRT			0.027
>/= 60 degrees	6	9	
< 60 degrees	29	144	
Level of surgery			0.665
L4L5&L5S1	33	141	
Other levels	2	12	
Change in SLRT at 1 week			0.000
</= 30 degrees	9	8	
>30 degrees	26	145	
Change in leg pain VAS at 1 week			0.006
</= 3	11	19	
> 3	24	134	
Type of disc prolapse		88	0.968
Contained	20	65	
Extruded	15		

When a multivariate analysis taking the change in the revised ODI at 6 months as a dependent variable was done the duration of the last episode of pain and change in the degree of SLRT at the seventh postoperative day were found to be statistically significant while the preoperative degree of SLRT, the level of surgery or the change in the leg pain VAS at the seventh postoperative day were not found to be statistically significant.

TABLE 5: Multivariate analysis of the change in the revised ODI score at 6 months as the dependent variable

Variable	Odds ratio (95 % confidence interval)	P value
Duration of the last episode of leg pain	0.36 (0.14 - 0.98)	0.046
Preoperative degree of SLRT	1.02 (0.97 - 1.07)	0.413
Level of surgery	0.69 (0.13 - 3.74)	0.669
Change in degree of SLRT at 7 days postoperative	4.88 (1.10 - 21.69)	0.037
Change in leg pain VAS at 7 days postoperative	1.37 (0.37 – 5.16)	0.639

Predictors of Macnab's index at 6 months

When the Macnab's index was assessed at the end of 6 months all 172 (91 %) patients irrespective of their initial symptoms had either a good or excellent recovery. When the change in the Macnab's index at 6 months was taken as a dependent variable the chi square test showed the duration of the last episode of pain, preoperative positive degree of SLRT, change in the degree of SLRT at the

seventh postoperative day and the VAS for change in leg pain at 1 week to be significant on univariate analysis. The age, sex, total duration of leg pain, the level of surgery or the type of disc prolapse were not found to be statistically significant.

TABLE 6: Univariate analysis of the change in the Macnab's score at 6 months as the dependent variable

Independent variables	Macnab's score at 6 months				P value
	POOR	FAIR	GOOD	EXCELLENT	
Age >40 years <40 years	 0 2	 9 7	 90 61	 7 12	0.094
Sex M F	 14 5	 10 6	 104 47	 0 2	0.219
Total duration of leg pain < =2 months > 2 months	 0 2	 1 15	 24 127	 2 17	0.761
Duration of last episode of pain < = 4 weeks >4 weeks	 0 2	 1 15	 100 51	 18 1	0.000
Preoperative SLRT > = 60 degrees < 60 degrees	 1 1	 8 8	 6 145	 0 19	0.000
Level of surgery L45&L5S1 Other levels	 2 0	 14 2	 141 10	 17 2	0.502
Type of disc prolapse Contained Extruded	 1 1	 9 7	 89 62	 9 10	0.806
Change in SLRT at 1 week <= 30 degrees >30 degrees	 2 0	 9 7	 6 145	 0 19	0.000
Change in leg pain VAS at 1 week </= 3 > 3	 2 0	 9 7	 18 133	 1 18	0.000

In multivariate analysis when the change in the Macnab's index at 6 months was taken as a dependent variable the duration of the last episode of pain and change in the degree of SLRT at the seventh postoperative day were found to be statistically significant. The preoperative degree of SLRT, the level of surgery or the change in the leg pain VAS at the seventh postoperative day were not found to be statistically significant on multivariate analysis.

TABLE 7: Multivariate analysis of the change in the Macnab's score at 6 months as the dependent variable

Variable	Odds ratio (95 % confidence interval)	P value
Duration of the last episode of leg pain	0.05 (0.01 - 0.52)	0.012
Preoperative degree of SLRT	1.01 (0.94 - 1.10)	0.740
Level of surgery	1.98 (0.18 - 22.04)	0.579
Change in degree of SLRT at 7 days postoperative	14.43 (2.14 – 97.19)	0.006
Change in leg pain VAS at 7 days postoperative	1.80 (0.33 – 9.83)	0.499

Similarly when the Macnab's index was assessed at the end of 1 year all 176 (98 %) patients irrespective of their initial symptoms all had either a good or excellent recovery. When the change in the Macnab's index at 6 months and 1 year was taken as a dependent variable the chi square test showed the duration of the last episode of pain, preoperative degree of SLRT, change in the degree of SLRT at the seventh postoperative day and the VAS for change in leg pain at 1 week to be significant on univariate analysis. The age, sex, total duration of leg pain or the type or level of surgery were not found to be statistically significant.

Similar to the revised ODI score at 1 year all but 3 patients irrespective of their initial symptoms had a good or excellent outcome on the Macnab's index at 1 year. So while the independent variables

were significant in detecting change in Macnab's scale at 6 months, they lost their significance at the end of 1 year and ~ 99% of the patients showed a good or excellent outcome.

TABLE 8: Univariate analysis of the change in the Macnab's score at 1 year as the dependent variable

Variables	Macnab's score at 1 year				P value
	POOR	FAIR	GOOD	EXCELLENT	
Age >40 years <40 years	 0 0	 1 2	 91 61	 9 15	0.061
Sex M F	 0 0	 1 2	 105 47	 0 2	0.379
Total duration of leg pain < /=2 months > 2 months	 0 0	 0 3	 23 129	 3 21	1.000
Duration of last episode of pain < /= 4 weeks >4 weeks	 0 0	 0 3	 91 61	 23 1	0.000
Preoperative SLRT >/= 60 degrees < 60 degrees	 0 0	 2 1	 13 139	 0 24	0.006
Level of surgery L45&L5S1 Other levels	 0 0	 3 0	 141 11	 22 2	0.755
Type of disc prolapse Contained Extruded	 0 0	 2 1	 88 64	 12 12	0.725
Change in SLRT at 1 week <= 30 degrees >30 degrees	 0 0	 0 3	 14 138	 0 24	0.000
Change in leg pain VAS at 1 week </= 3 > 3	 0 0	 3 0	 24 128	 1 23	0.001

DISCUSSION

There have been numerous studies in patients with lumbar disc prolapse which have analyzed the outcomes of leg pain, return to work and other indices of outcome following operative and nonoperative interventions. Many epidemiological, clinical and radiological parameters have been studied for possible influence on the outcome and prognostic value. Three factors have been reported to have a significant effect on the result of surgery, namely the preoperative duration of the clinical syndrome, the surgical findings, and the degree of tension on the nerve root (10, 13).

Patients with pain for more than six months before surgery and those with annular bulging or contained disc herniation tend to obtain less satisfactory results than those with a shorter duration of pain and/or a migrated disc herniation (10). A satisfactory result is associated more often with markedly positive nerve-root tension tests (10). Patients with preoperative preponderance of radicular leg pain versus back pain had better surgical outcomes (56).

A number of environmental and inherent factors thought to influence the development of sciatica have been studied, including gender, body habitus, parity, age, genetic factors (eg.. genetic abnormalities in disc glycosaminoglycans and collagen fibres), occupation, and environmental factors (educational status, smoking, work environment, perception of injury, litigation etc)(13).

Effect of age and gender

Elderly patients have the same probability of surgical success as those who are younger (10, 55). Hodges et al. however found that males had a significantly greater improvement in ODI (25.8% vs. 2.6%) as compared with females (55). The surgical arm of the (232 patients) randomized SPORT trial had 44% (101)females and the mean age of their patients was 47.1 years with 62 % (143 patients) having a preoperative positive SLRT (64). In our study females were 68 % (128) and the mean age of the patients was 42.5 years (range 17 - 62 years). In our study we did not find age or sex to be statistically significant factors influencing the outcome.

Duration of symptoms versus outcome

The association between duration of symptoms and surgery-related result has been investigated previously by several authors. Jønsson investigated patient-related factors predicting the outcome after decompressive surgery in 120 patients with disc herniation and he found that long preoperative duration of sciatica and long preoperative duration of time absent from work had significant negative influence on the surgery-related outcome, as determined at the 2-year follow up (58).

Weber reported on herniated lumbar discs in 208 patients among whom 126 were incapacitated by sciatica. At 10 years post treatment, results in the surgical and nonsurgical groups were essentially identical. A key finding was also that in patients in whom symptoms persisted for more than 3 months preoperatively, a far worse prognosis was demonstrated (3, 58). In our study the total duration of leg pain symptoms was not found to be significant. However, the duration of the last episode of pain was found to be significant with 97.4 % of patients who had symptoms for less than 4 weeks having a > 3 point improvement in the leg pain VAS and 92.1 % showing a > 50 point improvement from their preoperative ODI scores and all patients showing a good or excellent improvement on the Macnab's scale as compared to those with symptoms for >4 weeks.

Level of disc prolapse and outcome

Most lumbar disc surgery has involved L4–L5, L5–S1 segments, a preoperative positive passive SLRT result at under 30°, an expectation that most of the postoperative improvement will take place in the first 4 months, (slowing toward 12 months), and an outcome adversely influenced by compensation claims and psychosocial factors(17). Many series have suggested that the L4L5 interspace is affected more commonly than the L5S1(34). In the SPORT randomized trial the L4 L5 (80 (34%)) and L5 S1(136 (59%)) levels were most commonly involved (64). 92.5 % of our disc prolapses were at the L4L5 (105 (55.9%)) or L5S1 (66 (35.1%)) levels. In our study the level of disc prolapse was not found to influence the outcome measures.

Degree of preoperative SLRT versus outcome

Jønsson and Stro¨mqvist noted that a positive preoperative passive SLRT correlated with the neurologic deficit but not with the postoperative recovery (17). They, however, reported a strong correlation between a positive SLRT at 4 month after surgery and re-operation with a poor prognosis, being poorer for females than males (17). A negative SLRT at the 4-month postoperative point predicted an excellent prognosis (17, 19). However, there are no studies on the change in degree of the SLRT in the early postoperative period (7^{th} postoperative day) as a prognostic variable. In our study 93.9 % of patients with a preoperative SLRT of <60 degrees had a >3 point improvement in their leg pain VAS at 1 year, 83.2 % of patients had a > 50 point change in the ODI scores at 6 months and 99.4 % had an excellent or good response on the Macnab's scale at 1 year.

Change in SLRT at one week post operative versus outcome

None of the studies have studied the correlation between the change in the degree of SLRT and the outcome of discectomy. We found a > 30 degree change in the SLRT to correlate significantly with the improvement in leg pain (VAS) and outcome assessed by the Macnab's scale and ODI on univariate and multivariate analysis.

Type of disc prolapse and outcome

Various studies have looked into the type of disc prolapse (herniation, bulge, extrusion) and the symptoms and outcomes. 80 of our disc prolapses were extruded and 108 contained and we did not find the type of prolapse to be a significant factor for outcome. 67.8 % of disc prolapses in the study by Carragee et al. were contained. They found better postoperative outcomes in the contained disc prolapse group than in those with extruded disc prolapses with large annular tears, though poorer than patients with extruded discs and minimal annular tears. While patients who had extruded disc herniations with small annular tears (Fragment fissure herniations) did exceptionally well, with only

one recurrence after a mean of five year, the patients who had extruded fragments with large or massive annular defects (Fragment Defect herniations) accounted for most of the clinically important reherniations and reoperations over time (68). Pople and Griffith (69)and Burton et al anticipated a better surgical outcome in patients with extruded as opposed to "contained" discs, however they did not report on the outcomes of extruded versus contained discs (13, 56, 68) .

We did not find any statistically significant difference in outcomes between central and paracentral disc prolapses in our study. Zuckerman and Hsu have noted a better response to decompression when the herniations were mainly unilateral rather than broad-based (13).

FIGURE 3: T2W axial MRI of the lumbosacral spine of a patient, with a left paracentral disc prolapse, who had a good outcome.

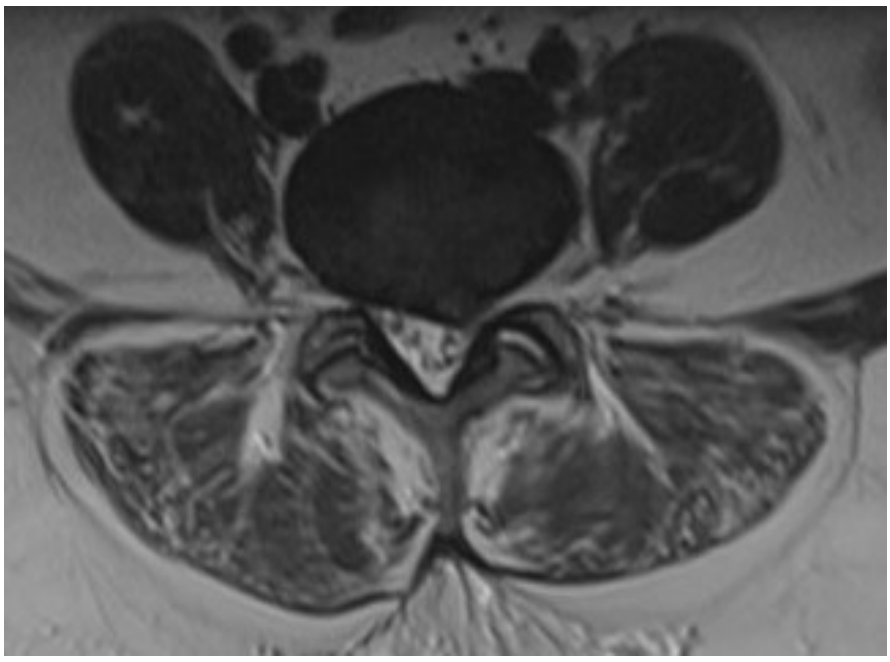

Figure 4: T2W sagittal MRI of the lumbosacral spine of a patient, with a left paracentral disc prolapse, who had a good outcome

Figure 5: T2W axial MRI of the lumbosacral spine of a patient, with a broad based right paracentral disc prolapse, who had a poor outcome.

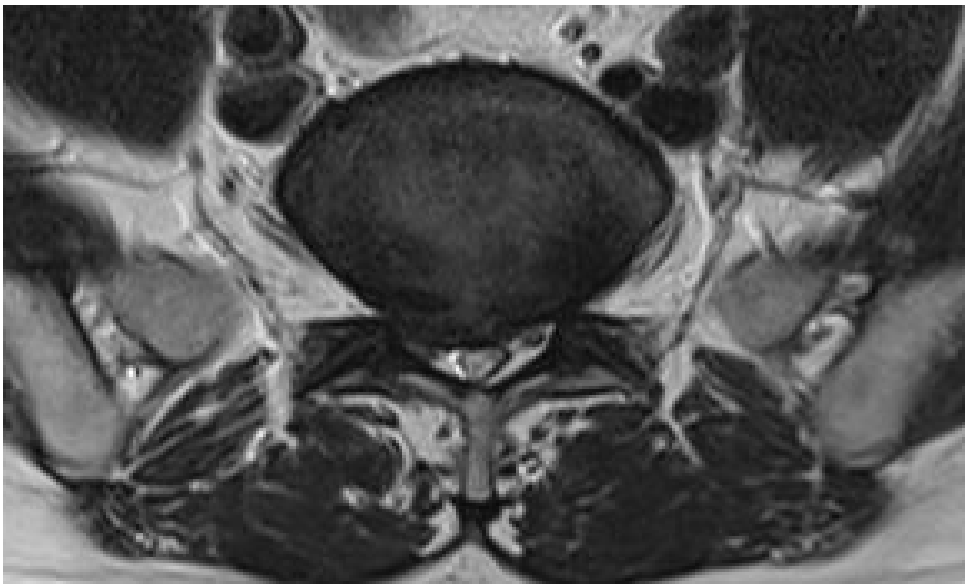

Figure 6: T2W sagittal MRI of the lumbosacral spine of a patient, with a L5S1 disc prolapse, who had a poor outcome

Type of surgery and outcome

Schisms et al. report on 28 patients with a lumbar disc herniation, of whom half underwent traditional micro-discectomy and the other half underwent micro-endoscopic discectomy. Although there was no difference in pain outcomes between the 2 groups at the 1-year follow-up review the study supported the notion that the muscle-splitting method causes less postoperative pain (70, 71). With micro-discectomy, the stay in hospital after operation may be 24 hours or less. Reduced back pain allows a more rapid functional recovery and a faster return to sedentary work. After eight to 12 weeks, the results of micro discectomy are similar to those of conventional surgery (10, 55). Hodges et.al., found microdiscectomy patients to have a significantly greater improvement in both ODI and VAS as compared with fusion patients (55). 91 (48.4 %) of our patients had microscopic fenestration and discectomy while 97 (51.6 %) had a laminectomy and discectomy and there was no significant

difference in the outcomes between these groups. Studies found the use of the microscope lengthened the operative procedure, but did not appear to make any significant difference in peri-operative bleeding or other complications, length of in-patient stay or the formation of the scar tissue. There were no differences in the clinical outcomes and duration of sick leave (10, 72, 73).

Effect of occupation and workmen's compensation on outcome

It has been suggested that workers' compensation has a negative effect on the recovery of patients from work- related injuries (55). In the Maine lumbar spine study application for worker's compensation was found to show statistically significant correlation with a poorer outcome (8). Spurling in his study and also Campbell and Whitfield noted, that the incidence of dissatisfied patients in the compensation group was twice as large as in the whole group and this discrepancy was also noted when the patients were asked to evaluate the success or failure of the operation (54). Others have compared the recovery periods of workers' compensation patients with other patients and determined that payment of compensation delays recovery from low back injury (55). However few patients, irrespective of initial Workers' Compensation status, were receiving any disability compensation and approximately 80% were working at 10 years (8).

Outcome measures

Many clinical trials in spine disorders use disease specific measures including the Oswestry Disability Index (ODI) and numeric rating scales for back (BPNRS) and leg pain (LPNRS) instead of preference-based instruments (63). Correlations between the SF-6D and the ODI, BPNRS, and LPNRS were statistically significant (63). The results of SPORT are similar to the Maine Lumbar Spine Study and the classic Weber study. While there are no validated outcome measures that can be directly compared between SPORT and the Weber study, Weber's 1-year results of 33% more

patients with “good” results in the surgical group is similar to SPORT’s 21% more patients with major improvement and 26% having more satisfaction with symptoms 1 year after surgery (67).

We used the Macnab’s scale, the revised ODI score and the leg pain VAS to assess outcomes. We found that at 1 year all but 2 patients had a > 50 point improvement in the ODI scores and all but 3 patients had either good or excellent outcomes on the Macnab’s scale.

SUMMARY

OBJECTIVE:

To study the correlation between change in the degree of a positive straight leg raising test (SLRT) in the immediate preoperative period and seven days after surgery with the improvement in leg pain and functional outcome after surgery for lumbar disc prolapse.

MATERIALS AND METHODS:

The study included 216 consecutive patients with lumbar disc prolapse who had a preoperative positive SLRT who underwent surgery in our department between May 2006 and July 2009. All patients were screened preoperatively clinically and with a MRI scan of the lumbosacral spine. The change in degree of SLRT was measured using a goniometer and the change in the degree leg pain was measured using the visual analogue score (VAS). Using postal questionnaires at 6 months and 12 months the outcome and quality of life were assessed using the Macnab's criteria and the revised Oswestry Disability. 6 month follow up was available for 188 and 1 year follow up for 179 patients. Pearson's Chi square test was used to study correlation using STATA software v11.0.

RESULTS:

Of the 188 patients, 171 had a more than 30 degree improvement in the SLRT on the 7^{th} POD. At 1 year follow up 154 (90.06 %) of these patients had a more than 3 point improvement in their leg pain (VAS), 138 (80.70%) had good and 24 (14.04%) had excellent outcomes with the Macnab's score and 162 (94.74%) had a more than 50 percent improvement in their revised ODI scores at 6 months. A statistically significant correlation ($p < 0.05$) was found between > 30 degrees improvement in the degree of positive SLRT and duration of the last episode of leg pain and the outcomes as measured

by the Macnab's criteria and the revised Oswestry Disability Index at 6 months. A > 3 point change in the leg pain (VAS) in the early postoperative period correlated significantly with the improvement in leg pain at 1 year. Many other variables including the age, sex, total duration of leg pain, preoperative degree of SLRT, level and type of disc prolapse and type of surgery did not have an impact on the outcome of surgery.

CONCLUSIONS:

The change in the leg pain in the early postoperative period correlated significantly with the improvement in leg pain at 1 year, while the change in SLRT was not statistically significant. However the change in the degree of SLRT is a simple measure and showed a significant correlation with the functional outcome of lumbar disc surgery at 6 months. At 1 year most patients had a good or excellent outcome on Macnab's and >50 % improvement in their rODI scores irrespective of their initial status.

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APPENDICES

APPENDIX 1 : THESIS PROFORMA

Name:

Age: Sex:

Hospital number:

Address:

Phone number:

Date of surgery:

Diagnosis:

Presenting complaints:

Duration of symptoms:

Number of episodes of leg pain:

Any co-morbid illnesses:

Clinical features:

Treatment history:

MRI findings:

Surgery done:

Intraoperative findings:

Degree of straight leg raising (SLRT)

Preoperative (/ /) :
7th postoperative day (/ /) :

Leg pain on the visual analogue scale(VAS)

0 2 4 6 8 10

No pain Moderate pain Severe pain

Preoperative (/ /) :
7th postoperative day (/ /) :
6 months post operation(/ /) :
1 year post operation (/ /) :

Back pain on the visual analogue scale(VAS)

0 2 4 6 8 10

No pain Moderate pain Severe pain

Preoperative (/ /) :
7th postoperative day (/ /) :
6 months post operation(/ /) :
1 year post operation (/ /) :

Quality of life assessed by the Macnab's Disability Index:

6 months post operation(/ /) :
1 year post operation (/ /) :

Quality of life assessed by the Revised Oswestry Disability Index:

Preoperative (/ /) :
6 months post operation(/ /) :
1 year post operation (/ /) :

APPENDIX 2 : REVISED OSWESTRY DISABILITY INDEX

This questionnaire is designed to enable us to understand how much your low back has affected your ability to manage everyday activities. Please answer each Section by circling the **ONE CHOICE** that most applies to you. We realize that you may feel that more than one statement may relate to you, but please **just circle the one choice which closely describes your problem *right now.***

SECTION 1--Pain Intensity
A. The pain comes and goes and is very mild.
B. The pain is mild and does not vary much.
C. The pain comes and goes and is moderate.
D. The pain is moderate and does not vary much.
E. The pain is severe but comes and goes.
F. The pain is severe and does not vary much.

SECTION 2--Personal Care
A. I would not have to change my way of washing or dressing in order to avoid pain.
B. I do not normally change my way of washing or dressing even though it causes some pain.
C. Washing and dressing increase the pain, but I manage not to change my way of doing it.
D. Washing and dressing increase the pain and I it necessary to change my way of doing it.
E. Because of the pain, I am unable to do any washing and dressing without help.
F. Because of the pain, I am unable to do any washing or dressing even with help.

SECTION 3--Lifting
A. I can lift heavy weights without extra pain.
B. I can lift heavy weights, but it causes extra pain.
C. Pain prevents me from lifting heavy weights off the floor.
D. Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned, e.g. on the table.
E. Pain prevents me from lifting heavy weights , but I can manage light to medium weights if they are conveniently positioned.
F. I can only lift very light weights, at the most.

SECTION 4 --Walking
A. Pain does not prevent me from walking any distance.
B. Pain prevents me from walking more than 2 miles.
C. Pain prevents me from walking more than one mile.
D. Pain prevents me from walking more than 1/2 mile.
E. I can only walk while using a cane or on crutches.
F. I am in bed most of the time and have to crawl to the toilet bed.

SECTION 5--Sitting
A. I can sit in any chair as long as I like without pain.
B. I can only sit in my favorite chair as long as I like.
C. Pain prevents me from sitting more than one hour.
D. Pain prevents me from sitting more than 1/2 hour.
E. Pain prevents me from sitting more than ten minutes.
F. Pain prevents me from sitting at all.

SECTION 6 -- Standing
A. I can stand as long as I want without pain
B. I have some pain while standing, but it does not increase with time.
C. I cannot stand for longer than one hour without increasing pain.
D. I cannot stand for longer than ½ hour without increasing pain.
E. I can't stand for more than 10 minutes without increasing pain.
F. I avoid standing because it increases pain right away.

SECTION 7--Sleeping
A. I get no pain in bed.
B. I get pain in bed, but it does not prevent me from sleeping.
C. Because of pain, my normal night's sleep is reduced by less than one-quarter.
D. Because of pain, my normal night's sleep is reduced by less than one-half.
E. Because of pain, my normal night's sleep is reduced by less than three-quarters.
F. Pain prevents me from sleeping at all.

SECTION 8--Social Life
A. My social life is normal and gives me no pain.
B. My social life is normal, but increases the degree of my pain.
C. Pain has no significant effect on my social life apart from limiting my more energetic interests, e.g., running, jumping, dancing etc.
D. Pain has restricted my social life and I do not go out very often.
E. Pain has restricted my social life to my home.
F. I have hardly any social life because of the pain.

SECTION 9--Traveling
A. I get no pain while traveling.
B. I get some pain while traveling, but none of my usual forms of travel make it any worse.
C. I get extra pain while traveling, but it does not compel me to seek alternative forms of travel.
D. I get extra pain while traveling which compels me to seek alternative forms of travel.
E. Pain restricts all forms off travel.
F. Pain prevents all forms of travel except that done lying down.

SECTION 10--Changing Degree of Pain
A. My pain is rapidly getting better.
B. My pain fluctuates, but overall is definitely getting better.
C. My pain seems to be getting better, but improvement is slow at present.
D. My pain is neither getting better nor worse.
E. My pain is gradually worsening.
F. My pain is rapidly worsening.

DISABILITY INDEX SCORE: %____

HOSPITAL NUMBER:

NAME: DATE:

APPENDIX 3: FOLLOW UP QUESTIONNAIRE

PLEASE MARK THE APPROPRIATE ANSWERS TO THE ABOVE QUESTIONS AND MAIL THIS SHEET BACK TO US AT YOUR EARLIEST

1) HAVE YOU RETURNED TO NORMAL WORK AND ACTIVITY

- YES, I HAVE RETURNED TO NORMAL WORK AND ACTIVITY
- I HAVE RETURNED TO MODIFIED WORK AND ACTIVITY
- I HAVE NOT YET RETURNED TO WORK AND I AM STILL HANDICAPPED BY SYMPTOMS THOUGH TO A LESSER DEGREE
- NO, I AM STILL HANDICAPPED BY SYMPTOMS

2) HOW IS YOUR LEG PAIN

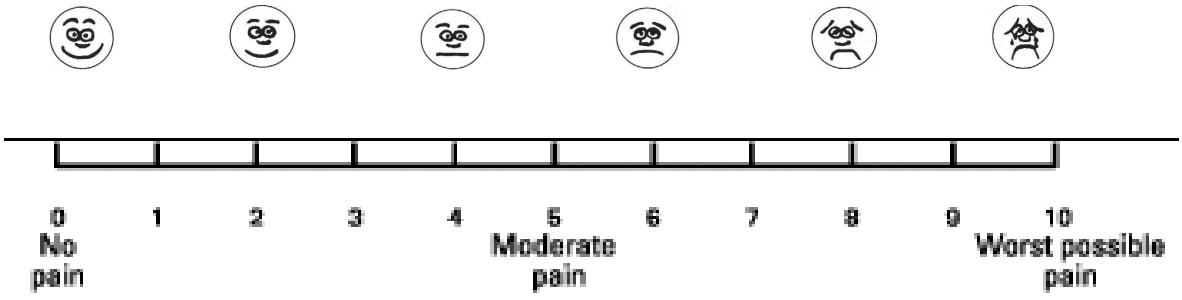
- I'M NOW FREE OF LEG PAIN.
- PAIN HAS DECREASED SIGNIFICANTLY, ONLY OCCASIONAL BACK PAIN AT PRESENT
- PAIN HAS DECREASED MINIMALLY BUT STILL NOT ABLE TO DO DAILY ACTIVITIES
- NO IMPROVEMENT IN THE LEG PAIN OR WORSENED

3) HOW IS YOUR MOBILITY

- I HAVE NO RESTRICTION OF MOBILITY
- I HAVE MINIMAL RESTRICTION OF MOBILITY
- I HAVE RESTRICTION OF MOBILITY AND I'M STILL HANDICAPPED BY SYMPTOMS THOUGH TO A LESSER DEGREE
- I HAVE SEVERE RESTRICTION OF MOBILITY

4) HOW SEVERE IS YOUR PAIN

ON A SCALE OF 0–10, WITH 0 BEING NO PAIN AND 10 BEING THE MOST INTENSE PAIN IMAGINABLE, YOUR PAIN SCORE BEFORE THE SURGERY WAS_____
CIRCLE THE NUMBER THAT BEST REPRESENTS THE SEVERITY OF INTENSITY OF YOUR PAIN RIGHT NOW. LEG _____ BACK _____



HOSP.NO:

NAME: DATE:

APPENDIX 4: MacNab Criteria

1) No pain and no functional restrictions = **Excellent**

2) Occasional back/leg pain, brief functional restrictions = **Good**

3) Improved overall function, permanent work and activities of daily living modification = **Fair**

4) Deterioration of symptoms or no improvement in work and activities of daily living= **Poor**

APPENDIX 5: Patient data sheet

Change in PAIN VAS
> 3 point change= 1
</=3 point change = 0

Change in SLRT degrees
>30 degrees = 1
</=30 degrees = 0

Change in ODI score
</=50 percent = 0
>50 percent = 1

Total duration of leg pain
>2 months = 1
<= 2months = 0

Duration of last episode of leg pain
>4 weeks = 1
<= 4weeks = 0

Level of the disc prolapse
L4/5 & L5/S1 = 1
any other disc level = 0

Preoperative degree of SLRT
< 60 degrees = 1
>/= 60 degrees = 0

	A	B	C	D	E	F	G	H	I
1	HOSP No	DATE OF Sx	AGE	SEX	PreopSLRT	7POD SLRT	PreopLP	7POD LP	6mPO LP
2	797876C	01/05/2006	30	M	20	85	6	0	0
3	781809C	22/05/2006	33	M	50	90	5	1	1
4	821701C	25/05/2006	41	F	40	80	6	1	0
5	822705C	29/05/2006	52	F	50	85	5	1	1
6	817077C	29/05/2006	36	M	20	90	6	2	0
7	843997C	26/06/2006	37	F	20	80	7	2	1
8	830100C	26/06/2006	26	M	30	80	6	1	1
9	813197C	04/07/2006	30	F	25	85	6	1	0
10	627095C	03/07/2006	50	M	50	90	4	1	0
11	815453C	18/07/2006	51	M	40	85	6	1	0
12	862098C	24/07/2006	28	M	20	80	6	1	0
13	869098C	04/08/2006	37	M	30	90	6	1	0
14	832622C	08/08/2006	51	F	20	80	5	2	1
15	825355C	08/08/2006	41	M	40	90	6	1	0
16	868958C	10/08/2006	59	F	30	85	5	1	0
17	858515C	14/08/2006	40	F	25	90	6	0	0
18	855906C	16/08/2006	48	F	60	80	6	2	1
19	869392C	21/08/2006	56	F	45	80	5	1	0
20	874334C	28/08/2006	51	M	30	80	6	2	1
21	868625C	04/09/2006	60	M	40	90	6	0	0
22	897010C	10/09/2006	55	F	60	85	5	1	1
23	885292C	10/09/2006	26	F	30	85	6	1	0
24	873657C	11/09/2006	50	M	40	90	5	1	0
25	893582C	22/09/2006	45	F	30	80	5	1	0
26	902613C	10/10/2006	36	M	30	90	6	1	1
27	867431C	13/10/2006	60	M	40	85	5	1	0
28	917356C	06/11/2006	53	M	35	85	5	0	0
29	913624C	13/11/2006	58	F	60	85	4	2	1
30	913495C	14/11/2006	44	M	25	85	6	0	0
31	486267C	21/11/2006	41	F	30	80	5	0	0
32	933267C	05/12/2006	26	F	25	85	6	0	0
33	947683C	18/12/2006	47	M	40	90	5	1	0
34	944758C	18/12/2006	18	M	25	90	6	1	0
35	945812C	1/3/2007	18	F	20	90	6	2	0
36	941146C	1/8/2007	47	M	25	90	6	0	0
37	540439C	1/9/2007	53	F	50	90	5	1	1
38	929825C	1/10/2007	38	M	20	80	7	2	1
39	956949C	1/22/2007	44	M	30	80	6	1	1
40	942233C	1/23/2007	44	F	50	90	4	1	0
41	942372C	1/24/2007	25	M	30	90	5	1	0
42	969467C	2/6/2007	35	M	40	80	4	0	0
43	917290C	2/16/2007	41	M	20	80	5	1	0
44	973440C	2/27/2007	36	M	60	85	4	1	1
45	984136C	3/10/2007	27	M	40	90	6	1	0
46	980594C	3/13/2007	35	M	65	90	4	1	2
47	966467C	3/20/2007	40	M	50	90	6	1	1
48	998222C	4/9/2007	28	M	70	90	3	1	2
49	997189C	4/16/2007	53	M	50	90	5	0	0

	J	K	L	M	N	O	P	Q
1	1yrPO LP	PreopODI	6mPO ODI	1yPO ODI	6mMACNAB	1yMACNAB	d0-6mODI	d0-1yODI
2	0	68	12	6	EXCELLENT	EXCELLENT	56	62
3	0	68	14	4	GOOD	GOOD	54	64
4	0	74	12	6	GOOD	EXCELLEN	62	68
5	1	66	14	8	GOOD	GOOD	52	58
6	0	70	10	8	GOOD	GOOD	60	62
7	0	64	8	6	GOOD	GOOD	56	58
8	0	66	12	4	GOOD	GOOD	54	62
9	0	78	12	8	GOOD	GOOD	66	70
10	0	72	12	6	GOOD	GOOD	0	66
11	0	70	14	6	GOOD	GOOD	56	64
12	0	76	10	4	EXCELLENT	EXCELLENT	66	72
13	0	62	10	6	GOOD	GOOD	52	56
14	0	70	16	8	GOOD	GOOD	54	62
15	0	74	12	6	GOOD	EXCELLEN	62	68
16	0	66	14	4	GOOD	GOOD	52	62
17	0	70	16	6	GOOD	EXCELLENT	54	64
18	1	74	16	8	GOOD	GOOD	58	66
19	0	66	10	8	GOOD	GOOD	56	58
20	0	72	14	6	GOOD	GOOD	58	66
21	0	64	14	8	GOOD	GOOD	50	56
22	0	78	18	10	FAIR	GOOD	60	68
23	0	74	12	8	GOOD	EXCELLENT	62	66
24	0	68	12	8	GOOD	GOOD	56	60
25	0	66	14	6	GOOD	GOOD	52	60
26	0	78	16	10	GOOD	GOOD	62	68
27	0	70	12	6	GOOD	GOOD	58	64
28	0	72	14	8	GOOD	GOOD	58	64
29	1	64	10	6	GOOD	GOOD	54	58
30	0	68	16	4	EXCELLENT	EXCELLENT	52	64
31	0	70	14	6	GOOD	GOOD	56	64
32	0	74	12	4	EXCELLENT	EXCELLENT	62	70
33	0	66	10	8	GOOD	GOOD	56	58
34	0	80	10	4	EXCELLENT	EXCELLENT	70	76
35	0	72	14	8	GOOD	GOOD	58	64
36	0	64	10	8	GOOD	GOOD	54	56
37	0	66	14	10	GOOD	GOOD	52	56
38	0	70	10	8	GOOD	GOOD	60	62
39	1	64	12	6	GOOD	GOOD	52	58
40	0	66	12	8	GOOD	GOOD	54	58
41	0	74	12	8	GOOD	GOOD	62	66
42	0	72	10	6	EXCELLENT	EXCELLENT	62	66
43	0	62	10	6	GOOD	GOOD	52	56
44	1	66	14	10	FAIR	GOOD	52	56
45	0	66	16	10	GOOD	GOOD	50	56
46	1	66	38	20	FAIR	FAIR	36	46
47	1	64	14	10	GOOD	GOOD	50	54
48	1	72	22	12	FAIR	GOOD	50	60
49	0	74	12	8	GOOD	GOOD	62	66

	R	S	T	U	V	W
1	last epi LP	total LP	no of epi LP	side	level o	type of IVDP
2	2	4	2	L	L4-L5	EXTRUDED
3	4	24	4	R	L5-S1	CONTAINED
4	3	6	2	R	L5-S1	CONTAINED
5	3	10	3	C	L4-L5	CONTAINED
6	5	6	2	R	L4-L5	EXTRUDED
7	3	5	2	R	L4-L5	EXTRUDED
8	6	12	3	R	L4-L5	EXTRUDED
9	4	24	4	C	L5-S1	CONTAINED
10	6	12	3	L	L4-L5	CONTAINED
11	6	2	2	L	L5-S1	CONTAINED
12	3	3	1	L	L5-S1	CONTAINED
13	4	6	2	R	L5-S1	EXTRUDED
14	4	6	2	L	L5-S1	CONTAINED
15	3	8	3	L	L4-L5	EXTRUDED
16	5	60	5	R	L5-S1	CONTAINED
17	3	6	4	L	L4-L5	CONTAINED
18	4	12	3	C	L4-L5	EXTRUDED
19	4	2	2	L	L4-L5	CONTAINED
20	4	12	3	R	L5-S1	CONTAINED
21	6	4	2	C	L4-L5	EXTRUDED
22	8	12	4	C	M	EXTRUDED
23	4	4	2	L	L5-S1	EXTRUDED
24	3	3	2	L	L4-L5	EXTRUDED
25	3	9	3	C	M	EXTRUDED
26	4	2	2	R	L4-L5	EXTRUDED
27	4	3	3	C	L4-L5	CONTAINED
28	6	2	2	L	L5-S1	CONTAINED
29	6	8	3	R	L2-3	CONTAINED
30	3	12	4	L	L4-L5	EXTRUDED
31	6	10	4	R	L4-L5	CONTAINED
32	2	2	2	R	L4-L5	CONTAINED
33	4	1	2	L	L2-3	CONTAINED
34	3	1	2	L	L3,4	EXTRUDED
35	4	24	3	R	L5-S1	EXTRUDED
36	2	12	3	C	L4-L5	CONTAINED
37	6	12	4	L	L4-L5	CONTAINED
38	3	6	4	C	M	CONTAINED
39	4	6	3	R	L4-L5	CONTAINED
40	4	4	2	L	L4-L5	EXTRUDED
41	6	12	3	R	L5-S1	CONTAINED
42	3	3	2	R	L5-S1	CONTAINED
43	8	6	3	L	L5-S1	CONTAINED
44	12	6	4	R	L5-S1	CONTAINED
45	6	1	1	C	L5-S1	CONTAINED
46	8	12	5	R	L4-L5	EXTRUDED
47	8	8	3	C	L5-S1	CONTAINED
48	16	4	2	R	L5-S1	CONTAINED
49	12	12	3	L	L5-S1	EXTRUDED

	X
1	type of Sx
2	FENEST & DISCEC
3	LAMINEC & DISCEC
4	FENEST & DISCEC
5	LAMINEC & DISCEC
6	LAMINEC & DISCEC
7	LAMINEC & DISCEC
8	FENEST & DISCEC
9	FENEST & DISCEC
10	LAMINEC & DISCEC
11	FENEST & DISCEC
12	FENEST & DISCEC
13	FENEST & DISCEC
14	FENEST & DISCEC
15	FENEST & DISCEC
16	FENEST & DISCEC
17	LAMINEC & DISCEC
18	LAMINEC & DISCEC
19	FENEST & DISCEC
20	PART LAMINEC Y& DISCEC
21	LAMINEC & DISCEC
22	LAMINEC & DISCEC
23	LAMINEC & DISCEC
24	FENEST & DISCEC
25	LAMINEC & DISCEC
26	FENEST & DISCEC
27	LAMINEC & DISCEC
28	FENEST & DISCEC
29	LAMINEC & DISCEC
30	FENEST & DISCEC
31	FENEST & DISCEC
32	FENEST & DISCEC
33	LAMINEC & DISCEC
34	LAMINEC & DISCEC
35	FENEST & DISCEC
36	LAMINEC & DISCEC
37	FENEST & DISCEC
38	FENEST & DISCEC
39	LAMINEC & DISCEC
40	FENEST & DISCEC
41	FENEST & DISCEC
42	FENEST & DISCEC
43	FENEST & DISCEC
44	FENEST & DISCEC
45	LAMINEC & DISCEC
46	FENEST & DISCEC
47	FENEST & DISCEC
48	FENEST & DISCEC
49	FENEST & DISCEC

	A	B	C	D	E	F	G	H	I
1	HOSP No	DATE OF Sx	AGE	SEX	PreopSLRT	7POD SLRT	PreopLP	7POD LP	6mPO LP
50	996187C	4/16/2007	58	M	40	90	6	1	0
51	002939D	4/23/2007	41	M	30	85	6	1	0
52	768961C	4/24/2007	51	M	20	90	6	0	0
53	987161C	4/30/2007	46	M	50	90	5	1	1
54	019777D	5/15/2007	37	M	20	90	6	2	0
55	989704C	5/22/2007	50	M	20	80	7	2	1
56	028724D	5/22/2007	40	F	30	80	6	1	1
57	020024D	5/29/2007	51	M	50	90	4	1	0
58	007508D	6/11/2007	36	F	20	80	6	1	0
59	037843D	6/13/2007	32	F	30	90	6	2	0
60	041955D	6/19/2007	40	M	30	85	5	1	0
61	038491D	6/20/2007	42	M	25	90	6	0	0
62	015574D	6/25/2007	40	M	45	80	5	1	1
63	021362D	6/25/2007	40	M	40	90	6	2	0
64	013579D	6/25/2007	35	F	40	85	5	2	1
65	030073D	6/26/2007	41	M	30	85	6	1	0
66	047181D	7/9/2007	45	M	60	90	5	1	0
67	012880D	7/10/2007	28	F	30	85	5	1	0
68	027580D	7/23/2007	47	M	30	80	6	1	1
69	037602D	7/24/2007	29	M	50	90	4	1	0
70	068640D	7/27/2007	39	M	20	80	6	1	0
71	660075A	7/30/2007	44	F	30	90	6	1	0
72	038573D	8/13/2007	33	M	30	85	5	1	1
73	071802D	8/17/2007	34	M	25	90	6	0	0
74	064545D	8/17/2007	35	M	50	90	5	0	0
75	051924D	8/17/2007	48	M	40	90	6	1	0
76	083459D	8/20/2007	43	M	30	90	6	1	0
77	080143D	9/3/2007	35	M	20	90	6	0	0
78	830211C	9/6/2007	56	M	50	90	5	1	1
79	085299D	9/11/2007	56	F	25	90	6	2	0
80	090103D	9/11/2007	49	M	25	80	7	2	1
81	068375D	9/24/2007	59	M	30	85	6	1	0
82	100814D	9/25/2007	41	M	45	90	5	1	0
83	102954D	10/9/2007	58	M	50	85	5	2	1
84	854127C	10/3/2007	28	M	30	90	6	0	0
85	095152D	10/5/2007	62	F	30	80	6	1	0
86	115823D	10/15/2007	57	M	55	90	4	1	0
87	082603D	10/15/2007	45	M	20	80	6	1	0
88	118409D	10/24/2007	53	M	20	90	6	2	0
89	103687D	10/24/2007	45	M	20	80	7	2	1
90	119855D	10/29/2007	32	F	35	80	6	1	1
91	119640D	11/2/2007	38	M	50	90	4	1	1
92	122777D	11/5/2007	37	M	30	90	5	1	0
93	866981B	11/6/2007	50	M	40	80	4	0	0
94	102670D	11/6/2007	45	F	30	85	6	1	1
95	124794D	11/9/2007	35	M	50	90	4	1	0
96	125149D	11/12/2007	31	F	30	90	6	1	0
97	961504C	11/19/2007	50	M	60	85	5	1	1

	J	K	L	M	N	O	P	Q
1	1yrPO LP	PreopODI	6mPO ODI	1yPO ODI	6mMACNAB	1yMACNAB	d0-6mODI	d0-1yODI
50	0	68	12	8	EXCELLENT	EXCELLEN	56	60
51	0	64	18	10	GOOD	GOOD	46	54
52	0	78	10	4	EXCELLENT	EXCELLENT	68	74
53	1	80	8	4	GOOD	GOOD	72	76
54	0	64	14	6	GOOD	GOOD	50	58
55	0	72	14	4	GOOD	GOOD	58	68
56	0	80	10	6	GOOD	GOOD	70	74
57	0	70	12	6	GOOD	GOOD	58	64
58	0	70	10	4	EXCELLENT	EXCELLENT	60	66
59	0	66	14	8	GOOD	GOOD	52	58
60	0	66	18	6	GOOD	GOOD	48	60
61	0	68	16	6	FAIR	GOOD	52	62
62	1	64	14	6	GOOD	GOOD	50	58
63	0	72	14	6	GOOD	GOOD	58	66
64	0	68	18	8	FAIR	GOOD	50	60
65	0	70	10	6	GOOD	GOOD	60	64
66	0	64	12	6	GOOD	GOOD	52	58
67	0	66	12	4	GOOD	GOOD	54	62
68	1	74	12	6	GOOD	GOOD	62	68
69	0	72	18	6	GOOD	GOOD	54	66
70	0	74	12	4	GOOD	GOOD	58	70
71	0	68	12	6	GOOD	GOOD	56	62
72	0	66	18	4	FAIR	GOOD	48	62
73	0	76	12	6	EXCELLENT	EXCELLEN	64	70
74	0	70	12	4	GOOD	GOOD	58	66
75	0	72	14	4	EXCELLENT	EXCELLEN	58	68
76	0	72	10	6	GOOD	GOOD	62	66
77	0	78	10	6	GOOD	GOOD	68	72
78	0	66	18	10	FAIR	GOOD	48	56
79	0	72	14	6	GOOD	GOOD	58	66
80	1	80	10	6	GOOD	GOOD	70	74
81	0	70	10	6	EXCELLENT	EXCELLEN	60	64
82	0	68	12	6	GOOD	GOOD	56	62
83	0	80	16	10	GOOD	GOOD	68	70
84	0	78	8	4	EXCELLENT	EXCELLENT	70	74
85	0	72	16	4	GOOD	GOOD	56	68
86	0	74	12	6	GOOD	GOOD	62	68
87	0	84	10	6	GOOD	GOOD	74	78
88	0	64	14	8	GOOD	GOOD	50	56
89	0	72	14	6	GOOD	GOOD	58	66
90	1	80	14	4	GOOD	GOOD	66	76
91	0	70	16	4	FAIR	GOOD	58	66
92	0	70	10	8	GOOD	GOOD	60	62
93	0	76	12	4	GOOD	GOOD	64	72
94	1	62	18	6	FAIR	GOOD	44	56
95	0	68	12	6	EXCELLENT	EXCELLENT	56	62
96	0	72	14	6	GOOD	GOOD	58	66
97	1	80	16	10	GOOD	GOOD	64	70

	R	S	T	U	V	W
1	last epi LP	total LP	no of epi LP	side	level o	type of IVDP
50	3	3	2	L	L4-L5	CONTAINED
51	3	12	3	L	L4-L5	CONTAINED
52	3	12	3	R	L4-L5	EXTRUDED
53	6	12	4	R	L5-S1	CONTAINED
54	4	8	3	R	L5-S1	CONTAINED
55	4	12	3	R	L4-L5	EXTRUDED
56	4	1	2	L	L5-S1	EXTRUDED
57	8	2	2	R	L5-S1	EXTRUDED
58	6	6	3	L	L5-S1	CONTAINED
59	4	8	4	C	L4-L5	EXTRUDED
60	3	12	2	L	L3,4	CONTAINED
61	3	8	3	L	L4-L5	CONTAINED
62	6	4	2	R	L4-L5	CONTAINED
63	6	8	3	C	L4-L5	EXTRUDED
64	6	24	3	R	L4-L5	CONTAINED
65	3	7	3	L	L3,4	EXTRUDED
66	8	8	3	L	L4-L5	EXTRUDED
67	4	12	4	C	L4-L5	CONTAINED
68	3	6	3	R	L4-L5	EXTRUDED
69	12	6	2	L	L4-L5	EXTRUDED
70	6	2	2	L	L5-S1	CONTAINED
71	8	36	5	L	L5-S1	CONTAINED
72	12	48	4	C	M	CONTAINED
73	3	12	3	C	L5-S1	EXTRUDED
74	4	6	3	L	L5-S1	CONTAINED
75	3	36	3	L	L4-L5	CONTAINED
76	4	24	4	R	L4-L5	CONTAINED
77	2	12	3	L	L4-L5	CONTAINED
78	8	6	3	R	L4-L5	CONTAINED
79	4	12	3	L	L4-L5	CONTAINED
80	3	12	4	L	L4-L5	CONTAINED
81	4	12	2	L	L4-L5	EXTRUDED
82	6	1	2	L	L5-S1	CONTAINED
83	6	12	3	R	M	CONTAINED
84	2	4	2	L	L5-S1	EXTRUDED
85	3	2	2	L	L4-L5	EXTRUDED
86	8	4	2	L	L4-L5	EXTRUDED
87	4	24	3	L	L5-S1	EXTRUDED
88	3	4	2	L	L4-L5	CONTAINED
89	4	6	3	R	L4-L5	EXTRUDED
90	3	6	3	R	L5-S1	EXTRUDED
91	10	24	5	C	L4-L5	EXTRUDED
92	4	9	3	L	L5-S1	EXTRUDED
93	6	4	2	C	L4-L5	CONTAINED
94	12	24	4	L	L4-L5	CONTAINED
95	4	7	3	R	L4-L5	EXTRUDED
96	3	6	3	L	M	CONTAINED
97	12	12	3	C	M	CONTAINED

	X
1	type of Sx
50	FENEST & DISCEC
51	PART LAMINEC Y& DISCEC
52	LAMINEC & DISCEC
53	FENEST & DISCEC
54	FENEST & DISCEC
55	FENEST & DISCEC
56	LAMINEC & DISCEC
57	FENEST & DISCEC
58	LAMINEC & DISCEC
59	LAMINEC & DISCEC
60	FENEST & DISCEC
61	PART LAMINEC Y& DISCEC
62	LAMINEC & DISCEC
63	LAMINEC & DISCEC
64	FENEST & DISCEC
65	LAMINEC & DISCEC
66	LAMINEC & DISCEC
67	LAMINEC & DISCEC
68	FENEST & DISCEC
69	FENEST & DISCEC
70	FENEST & DISCEC
71	LAMINEC & DISCEC
72	FENEST & DISCEC
73	PART LAMINEC Y& DISCEC
74	MARS FENEST & DISCEC
75	MARS FENEST & DISCEC
76	LAMINEC & DISCEC
77	FENEST & DISCEC
78	LAMINEC & DISCEC
79	LAMINEC & DISCEC
80	MARS FENEST & DISCEC
81	LAMINEC & DISCEC
82	MARS FENEST & DISCEC
83	LAMINEC & DISCEC
84	MARS FENEST & DISCEC
85	MARS FENEST & DISCEC
86	FENEST & DISCEC
87	FENEST & DISCEC
88	MARS FENEST & DISCEC
89	LAMINEC & DISCEC
90	MARS FENEST & DISCEC
91	LAMINEC & DISCEC
92	FENEST & DISCEC
93	LAMINEC & DISCEC
94	LAMINEC & DISCEC
95	LAMINEC & DISCEC
96	FENEST & DISCEC
97	LAMINEC & DISCEC

	A	B	C	D	E	F	G	H	I
1	HOSP No	DATE OF Sx	AGE	SEX	PreopSLRT	7POD SLRT	PreopLP	7POD LP	6mPO LP
98	134165D	11/27/2007	60	F	25	90	6	0	0
99	131867D	11/27/2007	21	F	30	90	5	0	0
100	071798C	12/3/2007	38	F	30	85	6	1	0
101	146570D	12/4/2007	49	F	30	85	6	1	0
102	146474D	12/14/2007	42	M	45	90	5	1	0
103	139127D	12/15/2007	38	M	30	80	5	1	0
104	146901D	12/20/2007	51	M	30	80	6	1	1
105	155856D	12/20/2007	26	F	25	90	6	1	0
106	089334D	1/2/2008	28	F	20	80	6	2	1
107	119170D	1/7/2008	54	M	60	85	4	1	1
108	145597D	1/10/2008	30	F	30	80	6	1	1
109	150398D	1/14/2008	45	M	40	90	6	1	0
110	139326D	1/28/2008	39	F	55	90	4	1	0
111	111282D	2/4/2008	50	M	50	90	6	1	1
112	176126D	2/18/2008	43	F	45	90	5	1	1
113	182012D	3/10/2008	55	M	50	90	5	0	0
114	195525D	3/12/2008	37	M	40	90	6	1	0
115	787685C	4/9/2008	43	M	30	85	6	1	0
116	200692D	4/22/2008	58	M	50	90	5	1	1
117	226014D	5/5/2008	37	M	20	90	6	2	0
118	207874D	5/6/2008	50	M	20	80	7	2	1
119	225956D	5/16/2008	17	M	30	80	6	1	0
120	231343D	5/26/2008	50	M	40	85	5	2	2
121	236217D	5/26/2008	47	F	30	85	6	1	0
122	221660D	6/6/2008	59	M	40	90	5	1	0
123	250406D	6/11/2008	35	F	30	85	5	1	0
124	245039D	6/9/2008	61	M	30	80	6	1	1
125	252260D	6/17/2008	38	M	50	90	4	1	0
126	257648D	6/23/2008	57	F	20	80	6	1	0
127	605920B	6/29/2008	52	M	30	90	6	1	0
128	258762D	7/9/2008	34	M	50	90	5	1	1
129	252100D	7/10/2008	38	M	20	90	6	2	0
130	259465D	7/15/2008	49	M	20	80	7	2	1
131	269901D	7/16/2008	40	M	30	80	6	1	1
132	258423D	7/24/2008	37	M	50	90	4	1	0
133	246955D	8/4/2008	40	F	35	80	4	0	0
134	231097D	8/4/2008	54	M	20	80	5	1	0
135	262912D	8/11/2008	50	F	60	85	4	1	1
136	274282D	8/18/2008	51	M	40	90	6	1	0
137	281590D	8/18/2008	45	F	20	90	6	2	0
138	292013D	8/19/2008	38	M	20	80	7	2	1
139	253240D	9/1/2008	51	M	30	80	6	1	1
140	242974D	9/4/2008	55	F	20	90	6	0	0
141	275437D	9/9/2008	33	F	30	80	6	1	1
142	309885D	9/16/2008	37	M	50	90	5	1	0
143	310231D	9/22/2008	32	M	40	80	4	0	0
144	316440D	10/1/2008	40	M	30	80	6	1	1
145	313805D	10/14/2008	44	M	50	90	4	1	0

	J	K	L	M	N	O	P	Q
1	1yrPO LP	PreopODI	6mPO ODI	1yPO ODI	6mMACNAB	1yMACNAB	d0-6mODI	d0-1yODI
98	0	64	14	6	GOOD	GOOD	50	58
99	0	72	14	6	GOOD	GOOD	58	66
100	0	70	12	6	GOOD	GOOD	58	64
101	0	70	12	4	GOOD	GOOD	58	66
102	0	68	12	8	GOOD	GOOD	56	60
103	0	80	12	6	GOOD	GOOD	68	74
104	0	72	16	4	GOOD	GOOD	56	68
105	0	74	12	6	GOOD	GOOD	62	68
106	0	70	20	10	GOOD	GOOD	50	60
107	1	66	14	8	GOOD	GOOD	52	58
108	0	78	16	6	GOOD	GOOD	62	72
109	0	68	12	4	GOOD	GOOD	56	64
110	0	74	16	10	POOR	FAIR	58	64
111	0	72	14	6	GOOD	GOOD	58	66
112	1	64	16	10	GOOD	GOOD	48	54
113	0	70	12	10	GOOD	GOOD	58	60
114	0	68	12	4	GOOD	GOOD	56	64
115	0	68	16	6	GOOD	GOOD	52	62
116	0	80	16	10	GOOD	GOOD	64	70
117	0	64	14	8	GOOD	GOOD	50	56
118	0	72	14	10	GOOD	GOOD	58	62
119	0	80	10	6	GOOD	EXCELLENT	70	74
120	0	70	22	8	FAIR	GOOD	48	62
121	0	64	12	8	GOOD	GOOD	52	56
122	0	76	16	6	GOOD	GOOD	60	70
123	0	72	14	10	GOOD	GOOD	58	62
124	0	80	10	6	GOOD	GOOD	70	74
125	0	64	14	8	GOOD	GOOD	50	56
126	0	72	14	6	GOOD	GOOD	58	66
127	0	80	10	4	GOOD	GOOD	70	76
128	0	70	12	6	GOOD	GOOD	58	64
129	0	70	20	4	GOOD	GOOD	50	66
130	0	62	12	8	GOOD	GOOD	50	54
131	0	66	10	6	GOOD	GOOD	56	60
132	0	64	16	6	GOOD	GOOD	48	58
133	0	76	12	4	EXCELLENT	EXCELLENT	64	72
134	0	80	14	6	GOOD	GOOD	66	74
135	1	64	20	12	FAIR	FAIR	44	52
136	0	74	14	4	GOOD	GOOD	60	70
137	0	80	10	6	GOOD	GOOD	70	74
138	0	70	12	4	GOOD	GOOD	58	66
139	0	66	10	6	GOOD	GOOD	56	60
140	0	78	10	4	EXCELLENT	EXCELLENT	68	74
141	0	72	14	6	GOOD	GOOD	58	66
142	0	68	14	8	GOOD	GOOD	54	60
143	0	70	10	8	GOOD	GOOD	60	62
144	0	68	16	10	GOOD	GOOD	52	58
145	0	66	12	8	GOOD	GOOD	54	58

	R	S	T	U	V	W
1	last epi LP	total LP	no of epi LP	side	level o	type of IVDP
98	4	6	3	R	L4-L5	EXTRUDED
99	3	8	3	R	L4-L5	CONTAINED
100	6	10	4	R	L4-L5	CONTAINED
101	3	7	3	L	L4-L5	CONTAINED
102	8	6	3	L	L4-L5	EXTRUDED
103	3	8	3	L	L4-L5	EXTRUDED
104	3	12	4	C	L4-L5	CONTAINED
105	3	9	3	R	L4-L5	CONTAINED
106	2	6	3	L	L5-S1	CONTAINED
107	8	12	3	L	L4-L5	CONTAINED
108	6	12	2	R	L5-S1	CONTAINED
109	8	12	3	R	L5-S1	CONTAINED
110	16	6	2	R	L4-L5	CONTAINED
111	6	36	3	L	L4-L5	EXTRUDED
112	8	60	5	L	L4-L5	CONTAINED
113	6	72	4	R	L4-L5	EXTRUDED
114	4	12	3	R	L2-3	EXTRUDED
115	4	3	2	L	L5-S1	CONTAINED
116	6	48	4	L	L4-L5	EXTRUDED
117	3	2	2	R	L4-L5	EXTRUDED
118	4	4	2	L	L4-L5	CONTAINED
119	3	2	2	R	L4-L5	CONTAINED
120	6	6	2	C	L3,4	CONTAINED
121	4	6	3	C	L4-L5	CONTAINED
122	4	12	2	C	L4-L5	CONTAINED
123	4	12	3	R	L4-L5	EXTRUDED
124	3	24	4	L	L4-L5	EXTRUDED
125	8	4	2	L	L4-L5	EXTRUDED
126	3	12	3	R	L5-S1	CONTAINED
127	3	24	4	C	L4-L5	CONTAINED
128	8	12	3	L	L4-L5	CONTAINED
129	2	6	2	R	L5-S1	EXTRUDED
130	3	3	2	R	L4-L5	EXTRUDED
131	4	2	2	L	L4-L5	CONTAINED
132	3	1.5	2	L	L4-L5	CONTAINED
133	2	6	3	L	L4-L5	CONTAINED
134	3	8	4	L	L4-L5	CONTAINED
135	6	12	4	L	L4-L5	CONTAINED
136	4	18	5	R	L2-3	CONTAINED
137	4	24	4	R	L5-S1	CONTAINED
138	3	3	2	L	L5-S1	EXTRUDED
139	3	24	3	L	L5-S1	CONTAINED
140	2	24	4	L	L4-L5	EXTRUDED
141	4	1	2	R	L5-S1	CONTAINED
142	8	5	3	L	L4-L5	EXTRUDED
143	4	2	2	R	L5-S1	CONTAINED
144	3	12	4	R	L4-L5	CONTAINED
145	6	3	2	R	L5-S1	CONTAINED

	X
1	type of Sx
98	MARS FENEST & DISCEC
99	LAMINEC & DISCEC
100	LAMINEC & DISCEC
101	LAMINEC & DISCEC
102	FENEST & DISCEC
103	LAMINEC & DISCEC
104	LAMINEC & DISCEC
105	MARS FENEST & DISCEC
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114	LAMINEC & DISCEC
115	MARS FENEST & DISCEC
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119	MARS FENEST & DISCEC
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125	LAMINEC & DISCEC
126	MARS FENEST & DISCEC
127	LAMINEC & DISCEC
128	LAMINEC & DISCEC
129	FENEST & DISCEC
130	FENEST & DISCEC
131	MARS FENEST & DISCEC
132	MARS FENEST & DISCEC
133	MARS FENEST & DISCEC
134	LAMINEC & DISCEC
135	LAMINEC & DISCEC
136	LAMINEC & DISCEC
137	MARS FENEST & DISCEC
138	LAMINEC & DISCEC
139	MARS FENEST & DISCEC
140	LAMINEC & DISCEC
141	LAMINEC & DISCEC
142	LAMINEC & DISCEC
143	MARS FENEST & DISCEC
144	FENEST & DISCEC
145	LAMINEC & DISCEC

	A	B	C	D	E	F	G	H	I
1	HOSP No	DATE OF Sx	AGE	SEX	PreopSLRT	7POD SLRT	PreopLP	7POD LP	6mPO LP
146	305776D	10/15/2008	37	M	35	85	5	0	0
147	306592D	10/17/2008	40	M	20	80	5	1	0
148	333684D	10/24/2008	41	M	45	90	5	1	1
149	300934D	10/28/2008	50	M	20	90	6	2	0
150	084426D	11/3/2008	42	M	30	80	7	2	1
151	338806D	11/3/2008	41	F	30	80	6	1	1
152	334620D	11/10/2008	53	M	50	90	4	1	0
153	334491D	11/10/2008	32	F	55	70	6	3	1
154	338458D	11/14/2008	46	F	40	90	6	1	0
155	322972D	11/17/2008	56	M	40	90	6	0	0
156	292415D	11/21/2008	49	M	20	90	5	1	0
157	340033D	11/23/2008	41	F	60	85	4	1	1
158	312197D	11/24/2008	36	M	40	90	6	1	0
159	363519D	12/1/2008	37	F	50	90	5	1	1
160	349358D	12/2/2008	33	M	20	90	6	2	0
161	356376D	12/5/2008	46	F	20	80	7	2	1
162	370626D	12/11/2008	46	M	30	80	6	1	1
163	375265D	12/26/2008	46	M	50	90	4	1	0
164	533367C	1/14/2009	57	M	30	90	5	1	0
165	353419D	1/23/2009	51	F	40	80	4	0	0
166	386173D	1/28/2009	47	M	60	85	4	1	1
167	386891D	2/2/2009	37	F	40	90	6	1	0
168	414509D	3/2/2009	34	F	65	90	4	1	2
169	380523D	3/3/2009	36	M	50	90	6	1	1
170	407341D	3/5/2009	56	M	70	90	3	1	1
171	257242D	3/6/2009	43	M	50	90	5	0	0
172	399578D	3/6/2009	42	M	40	90	6	1	0
173	163047C	3/9/2009	55	M	30	85	5	1	0
174	384883D	3/10/2009	54	M	60	80	4	1	1
175	412730D	3/12/2009	19	M	50	90	6	1	0
176	415654D	3/23/2009	43	M	20	80	6	1	0
177	441796D	4/15/2009	34	F	20	90	6	2	0
178	420496D	4/20/2009	41	F	20	80	7	2	1
179	429596D	4/24/2009	39	M	30	80	6	1	1
180	802686D	4/27/2009	36	M	30	80	6	1	1
181	451512D	5/5/2009	29	M	50	90	4	1	0
182	418395D	5/1/2009	57	M	20	80	6	1	0
183	441155D	5/1/2009	46	F	30	90	6	1	0
184	459163D	5/29/2009	38	M	40	80	6	1	1
185	404444D	6/16/2009	21	M	25	90	6	2	0
186	384889D	6/16/2009	39	M	25	80	7	2	1
187	425530D	7/13/2009	50	F	30	80	6	1	0
188	477824D	7/13/2009	41	M	55	90	4	1	0
189	489171D	7/27/2009	47	F	20	80	6	1	0

	J	K	L	M	N	O	P	Q
1	1yrPO LP	PreopODI	6mPO ODI	1yPO ODI	6mMACNAB	1yMACNAB	d0-6mODI	d0-1yODI
146	0	74	10	4	EXCELLENT	EXCELLENT	64	70
147	0	72	16	6	GOOD	GOOD	56	66
148	0	76	14	6	GOOD	GOOD	62	70
149	0	78	14	8	GOOD	GOOD	64	70
150	0	68	12	6	GOOD	GOOD	56	62
151	0	66	16	4	GOOD	GOOD	50	62
152	0	64	12	6	GOOD	GOOD	52	58
153	1	72	24	12	FAIR	GOOD	48	60
154	0	74	12	8	GOOD	GOOD	62	66
155	0	64	10	6	GOOD	GOOD	54	58
156	0	62	10	6	GOOD	GOOD	52	56
157	0	64	16	12	FAIR	GOOD	48	52
158	0	80	8	4	EXCELLENT	EXCELLENT	72	76
159	0	64	14	8	GOOD	GOOD	50	56
160	0	72	14	10	GOOD	GOOD	58	62
161	0	80	10	8	GOOD	GOOD	70	72
162	0	70	12	8	GOOD	GOOD	58	62
163	0	70	14	6	GOOD	GOOD	56	64
164	0	74	12	8	GOOD	GOOD	62	66
165	0	76	10	6	EXCELLENT	EXCELLENT	66	70
166	1	66	14	10	FAIR	GOOD	52	56
167	0	64	16	10	GOOD	GOOD	48	54
168	1	66	20	16	POOR	GOOD	46	50
169	0	64	14	10	GOOD	GOOD	50	54
170	0	72	22	12	FAIR	GOOD	50	60
171	0	74	12	8	GOOD	GOOD	62	66
172	0	68	14	8	GOOD	GOOD	54	60
173	0	64	12	8	GOOD	GOOD	54	56
174	1	64	12	10	GOOD	GOOD	62	54
175	0	72	18	6	GOOD	GOOD	54	66
176	0	74	12	8	GOOD	GOOD	58	66
177	0	64	14	8	GOOD	GOOD	50	56
178	1	72	14	6	GOOD	GOOD	58	66
179	0	80	10	6	GOOD	GOOD	70	74
180	0	74	12	8	GOOD	GOOD	62	66
181		72	18		GOOD		54	
182		74	12		GOOD		58	
183		68	12		GOOD		56	
184		80	10		GOOD		70	
185		72	14		GOOD		58	
186		80	10		GOOD		70	
187		72	16		GOOD		56	
188		74	12		GOOD		62	
189		78	12		GOOD		66	

	R	S	T	U	V	W
1	last epi LP	total LP	no of epi LP	side	level o	type of IVDP
146	3	6	3	L	L4-L5	EXTRUDED
147	3	60	3	R	L4-L5	CONTAINED
148	4	6	3	L	L4-L5	EXTRUDED
149	3	2	2	R	L4-L5	EXTRUDED
150	3	24	5	R	L4-L5	EXTRUDED
151	3	36	4	R	L5-S1	CONTAINED
152	6	2	2	R	L4-L5	EXTRUDED
153	6	4	3	R	L5-S1	EXTRUDED
154	4	4	2	R	L4-L5	CONTAINED
155	4	24	3	L	L4-L5	CONTAINED
156	3	6	3	L	L4-L5	EXTRUDED
157	10	6	2	R	L5-S1	EXTRUDED
158	4	24	3	L	L5-S1	CONTAINED
159	8	3	2	R	L5-S1	EXTRUDED
160	4	1	2	R	L5-S1	EXTRUDED
161	3	2	2	R	L5-S1	EXTRUDED
162	3	2	2	L	L4-L5	CONTAINED
163	3	3	2	L	L4-L5	EXTRUDED
164	3	1	2	L	L4-L5	EXTRUDED
165	4	8	2	L	L3,4	CONTAINED
166	8	1	2	L	L4-L5	EXTRUDED
167	4	5	3	R	L5-S1	EXTRUDED
168	12	3	2	L	L4-L5	EXTRUDED
169	6	6	3	R	L5-S1	EXTRUDED
170	8	4	3	R	L4-L5	EXTRUDED
171	6	60	5	L	L5-S1	CONTAINED
172	4	24	5	R	L5-S1	EXTRUDED
173	3	24	5	L	L5-S1	CONTAINED
174	10	6	2	R	L4-L5	CONTAINED
175	12	6	2	L	L5-S1	CONTAINED
176	3	4	2	R	L5-S1	CONTAINED
177	4	12	3	L	L5-S1	CONTAINED
178	4	6	3	R	L4-L5	EXTRUDED
179	3	6	2	L	L5-S1	EXTRUDED
180	4	3	2	L	L5-S1	CONTAINED
181	8	3	2	L	L4-L5	CONTAINED
182	4	24	4	L	L4-L5	CONTAINED
183	6	6	2	C	L5-S1	EXTRUDED
184	6	2	2	C	L5-S1	EXTRUDED
185	3	6	3	C	L4-L5	CONTAINED
186	3	36	4	C	L3,4	CONTAINED
187	3	12	3	R	L5-S1	EXTRUDED
188	10	12	3	R	L4-L5	CONTAINED
189	4	96	5	L	L4-L5	CONTAINED

	X
1	type of Sx
146	LAMINEC & DISCEC
147	LAMINEC & DISCEC
148	MARS FENEST & DISCEC
149	PART LAMINEC Y& DISCEC
150	LAMINEC & DISCEC
151	FENEST & DISCEC
152	FENEST & DISCEC
153	FENEST & DISCEC
154	FENEST & DISCEC
155	FENEST & DISCEC
156	FENEST & DISCEC
157	MARS FENEST & DISCEC
158	PART LAMINEC Y& DISCEC
159	PART LAMINEC Y& DISCEC
160	MARS FENEST & DISCEC
161	FENEST & DISCEC
162	PART LAMINEC Y& DISCEC
163	LAMINEC & DISCEC
164	LAMINEC & DISCEC
165	LAMINEC & DISCEC
166	FENEST & DISCEC
167	PART LAMINEC Y& DISCEC
168	LAMINEC & DISCEC
169	FENEST & DISCEC
170	LAMINEC & DISCEC
171	LAMINEC & DISCEC
172	FENEST & DISCEC
173	LAMINEC & DISCEC
174	LAMINEC & DISCEC
175	FENEST & DISCEC
176	FENEST & DISCEC
177	FENEST & DISCEC
178	FENEST & DISCEC
179	FENEST & DISCEC
180	FENEST & DISCEC
181	FENEST & DISCEC
182	PART LAMINEC Y& DISCEC
183	PART LAMINEC Y& DISCEC
184	LAMINEC & DISCEC
185	LAMINEC & DISCEC
186	LAMINEC & DISCEC
187	LAMINEC & DISCEC
188	LAMINEC & DISCEC
189	LAMINEC & DISCEC